

AD-A175 812

HISTORIC PROPERTIES REPORT
REDSTONE ARSENAL, ALABAMA
WITH THE
GEORGE C. MARSHALL SPACE FLIGHT CENTER

FINAL REPORT

JULY 1964

20030128057

DTIC FILE COPY



This document was prepared under Contract CX-0001-2-0033
between Building Technology Incorporated, Silver Spring, Maryland
and the Historic American Building Survey/Historic American
Engineering Record, National Park Service
U.S. Department of the Interior

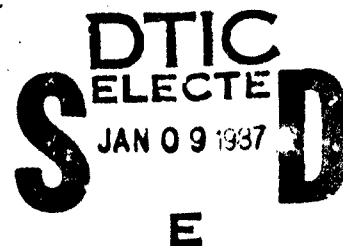
This document has been approved
for public release and sale in
distribution is unlimited.

87 1 8 039

HISTORIC PROPERTIES REPORT
REDSTONE ARSENAL, ALABAMA
WITH THE
GEORGE C. MARSHALL SPACE FLIGHT CENTER

FINAL REPORT

JULY 1964



This document was prepared under Contract CX-0001-2-0033
between Building Technology Incorporated, Silver Spring, Maryland
and the Historic American Building Survey/Historic American
Engineering Record, National Park Service
U.S. Department of the Interior

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED
DATE 10-10-2001 BY 60322 UCBAW/STP

EXECUTIVE SUMMARY

Redstone Arsenal is the headquarters of the U.S. Army Missile Command (MICOM). It is located on approximately 40,000 acres in northern Alabama near the town of Huntsville, and has 1,838 buildings including laboratories, flight test ranges, and other specialized buildings and equipment. The present arsenal dates to World War II when the site served as a chemical munitions manufacturing and assembly center for the Army's Chemical and Ordnance Corps. In 1950, the Ordnance Guided Missile Center was established at the site and Redstone Arsenal became the Ordnance Department's principal center for rocket research and development. Today, Redstone Arsenal is responsible for managing the Army's missile and rocket program.

NASA's George C. Marshall Space Flight Center is located within the boundaries of Redstone Arsenal on 1,840 acres of land leased to NASA by special agreement with the Army. The facility was established in 1960 and is currently one of NASA's primary centers for aerospace research, design, and development. The laboratories, test stands, and high-bay facilities at the center can accommodate space system components through all stages of development and flight readiness testing.

The Redstone Rocket Test Stand (Building 4665), located at the Marshall Space Flight Center, is a Category I historic property listed on the National Register of Historic Places. Several specialized test facilities at the Marshall Space Flight Center are significant engineering structures associated with the national space program and are Category II historic properties: Neutral

Bouyancy Simulator, Solid Rocket Motor Propulsion and Structural Test Facility, Structures and Mechanics Laboratory, Acoustic Model Engine Test Facility, Structural Dynamics Test Facility, Propulsion and Structural Test Facility, and High Reynolds Number Wind Tunnel. There are two Category III historic properties: Fire Station #3 (Building 7102) and the Harris Residence (Building 8012). Both have local importance to the history of Redstone Arsenal.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<i>[Signature]</i>
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



CONTENTS

Executive Summary

PREFACE.....	1
1. INTRODUCTION.....	3
Scope.....	3
Methodology.....	4
2. HISTORICAL OVERVIEW.....	12
Background.....	12
Huntsville Arsenal: Site Development.....	14
Gulf Chemical Warfare Depot: Site Development.....	21
Redstone Ordnance Plant: Site Development.....	22
Redstone Arsenal: 1949 - Present.....	29
Marshall Space Flight Center: Background.....	32
Marshall Space Flight Center: Description of Major Facilities.....	33
3. PRESERVATION RECOMMENDATIONS.....	50
Background.....	50
Category I Historic Properties.....	55
Category II Historic Properties.....	56
Category III Historic Properties.....	57
BIBLIOGRAPHY.....	62

PREFACE

✓ This report presents the results of an historic properties survey of Redstone Arsenal, Huntsville, Alabama, including NASA's George C. Marshall Space Flight Center. Prepared for the United States Army Materiel Development and Readiness Command (DARCOM), the report is intended to assist the Army in bringing this installation into compliance with the National Historic Preservation Act of 1966 and its amendments, and related federal laws and regulations. To this end, the report focuses on the identification, evaluation, documentation, nomination, and preservation of historic properties at Redstone Arsenal. Chapter 1 sets forth the survey's scope and methodology; Chapter 2 presents an architectural, historical, and technological overview of the installation and its properties; and Chapter 3 identifies significant properties by Army category and sets forth preservation recommendations. Illustrations and an annotated bibliography supplement the text.

This report is part of a program initiated through a memorandum of agreement between the National Park Service, Department of the Interior, and the U.S. Department of the Army. The program covers 74 DARCOM installations and has two components: 1) a survey of historic properties (districts, buildings, structures, and objects), and 2) the development of archeological overviews. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, directed the program for the Army, and Dr. Robert J. Kapsch, Chief of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) directed the program for the National Park Service. Sally Kress Tompkins was program manager, and Robie S. Lange was project

manager for the historic properties survey. Technical assistance was provided by Donald C. Jackson.

Building Technology Incorporated acted as primary contractor to HABS/HAER for the historic properties survey. William A. Brenner was BTI's principal-in-charge and Dr. Larry D. Lankton was the chief technical consultant. Major subcontractors were the MacDonald and Mack Partnership and Melvyn Green and Associates. The authors of this report were David G. Buchanan and John P. Johnson. The authors gratefully acknowledge the help and enthusiasm of Morris W. Schroder, Environmental Quality Coordinator at Redstone Arsenal.

The complete HABS/HAER documentation for these installations will be included in the HABS/HAER collections at the Library of Congress, Prints and Photographs Division, under the designations HAER No. AL-9.

Chapter 1

INTRODUCTION

SCOPE

This report is based on an historic properties survey conducted in 1983 of all Army-owned properties located within the official boundaries of Redstone Arsenal. The survey included the following tasks:

- Completion of documentary research on the history of the installation and its properties, and general research on the history of 1) chemical munitions manufacture in World War II, and 2) NASA space booster programs.**
- Completion of a field inventory of all properties at the installation.**
- Preparation of an architectural, historical, and technological overview for the installation.**
- Evaluation of historic properties and development of recommendations for preservation of these properties.**

Also completed as a part of the historic properties survey of the installation, but not included in this report, are HABS/HAER Inventory cards for 40 individual properties. These cards, which constitute HABS/HAER Documentation Level IV, will be provided to the Department of the Army. Archival copies of the cards, with their accompanying photographic negatives, will be transmitted to the HABS/HAER collections at the Library of Congress.

The methodology used to complete these tasks is described in the following section of this report.

METHODOLOGY

1. Documentary Research

The Redstone Arsenal has a history of chemical munitions manufacture and research and development in the field of rocketry. Research on the development of the arsenal and on specific aspects of the arsenal's activities in World War II and the post-war period was conducted at the Library of Congress and at the Historian's and Facilities Engineer's offices at Redstone.

The George C. Marshall Space Flight Center, located at the arsenal, is one of NASA's primary centers for the design and development of space transportation and orbital systems, and scientific applications and payloads. Background research pertaining to NASA rocket programs was conducted at the Library of Congress and research on specific properties at the Marshall Space Flight Center was conducted through the Master Planning Office and the Technical Library of the space flight center. The Alabama State Historic Preservation Office identified the Redstone Rocket Test Stand, which is listed on the National Register of Historic Places, as the only historic property at Redstone in their records.

Army records used for the field inventory included Real Property Inventory (RPI) printouts that listed all officially recorded buildings and structures by facility classification and date of construction; the installation's property record cards; base maps and photographs supplied by installation personnel; and installation master planning and environmental assessment and related reports and documents. A complete listing of this documentary material may be found in the bibliography.

2. Field Inventory

The field inventory was conducted by David G. Buchanan and John P. Johnson during a one-week period in May 1983. Morris W. Schroder, Environmental Quality Coordinator of Redstone Arsenal, served as the point of contact for the survey team and provided base maps, environmental assessment reports, and cultural resources reports. Ron Hagler, also of the Environmental Office, provided assistance and supplied maps and other documents. Mary Cagle, Historian, MICOM, and Mike Baker, Archivist, supplied installation histories and historic photographs, which were invaluable in conducting the inventory and preparing the historical overview. Carrie Hensen, Real Property Officer at Redstone Arsenal, provided access to the real property cards. Frank Showalter, Environmental and Energy Coordinator, Thiokol Corporation, escorted the survey team during its field inventory of Thiokol production areas at Redstone Arsenal. At the Marshall Space Flight Center, Robert G. Sheppard, Director of Management Operations, provided historical materials and facilitated the inventory by coordinating security and photography procedures. Ramon J. Samaniego, Jr., Master Planning Office, supplied real property records, master planning documents, and photographs of NASA facilities at the space flight center.

Field inventory procedures were based on the HABS/HAER Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures.¹ All areas and properties were visually surveyed. Building locations and approximate dates of construction were noted from the installation's property records and field-verified.

Field inventory forms were prepared for, and black and white 35 mm photographs taken of all buildings and structures through 1945 except basic utilitarian structures of no architectural, historical, or technological interest. When groups of similar ("prototypical") buildings were found, one field form was normally prepared to represent all buildings of that type. Field inventory forms were also completed for representative post-1945 buildings and structures.² Information collected on the field forms was later evaluated, condensed, and transferred to HABS/HAER Inventory cards.

3. Historic Overview

A combined architectural, historical, and technological overview was prepared from information developed from the documentary research and the field inventory. It was written in two parts: 1) an introductory description of the installation, and 2) a history of the installation by periods of development, beginning with pre-military land uses. Maps and photographs were selected to supplement the text when appropriate.

The objectives of the overview were to 1) establish the periods of major construction at the installation, 2) identify important events and individuals associated with specific historic properties, 3) describe patterns and locations of historic property types, and 4) analyze specific building and industrial technologies employed at the installation.

4. Property Evaluation and Preservation Measures

Based on information developed in the historical overviews, properties were first evaluated for historical significance in accordance with the

eligibility criteria for nomination to the National Register of Historic Places. These criteria require that eligible properties possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that they meet one or more of the following:³

- A. Are associated with events that have made a significant contribution to the broad patterns of our history.
- B. Are associated with the lives of persons significant in the nation's past.
- C. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- D. Have yielded, or may be likely to yield, information important in pre-history or history.

Properties thus evaluated were further assessed for placement in one of five Army historic property categories as described in Army Regulation 420-40:⁴

- | | |
|--------------|--|
| Category I | Properties of major importance |
| Category II | Properties of importance |
| Category III | Properties of minor importance |
| Category IV | Properties of little or no importance |
| Category V | Properties detrimental to the significance of
of adjacent historic properties |

Based on an extensive review of the architectural, historical, and technological resources identified on DARCOM installations nationwide, four criteria were developed to help determine the appropriate categorization level for each Army property. These criteria were used to assess the importance not only of properties of traditional historical interest, but of the vast number of standardized or prototypical buildings, structures, and production processes that were built and put into service during World War II, as well as of properties associated with many post-war technological achievements. The four criteria were often used in combination and are as follows:

- 1) Degree of importance as a work of architectural, engineering, or industrial design. This criterion took into account the qualitative factors by which design is normally judged: artistic merit, workmanship, appropriate use of materials, and functionality.
- 2) Degree of rarity as a remaining example of a once widely used architectural, engineering, or industrial design or process. This criterion was applied primarily to the many standardized or prototypical DARCOM buildings, structures, or industrial processes. The more widespread or influential the design or process, the greater the importance of the remaining examples of the design or process was considered to be. This criterion was also used for non-military structures such as farmhouses and other once prevalent building types.

- 3) Degree of integrity or completeness. This criterion compared the current condition, appearance, and function of a building, structure, architectural assemblage, or industrial process to its original or most historically important condition, appearance, and function. Those properties that were highly intact were generally considered of greater importance than those that were not.
- 4) Degree of association with an important person, program, or event. This criterion was used to examine the relationship of a property to a famous personage, wartime project, or similar factor that lent the property special importance.

The majority of DARCOM properties were built just prior to or during World War II, and special attention was given to their evaluation. Those that still remain do not often possess individual importance, but collectively they represent the remnants of a vast construction undertaking whose architectural, historical, and technological importance needed to be assessed before their numbers diminished further. This assessment centered on an extensive review of the military construction of the 1940-1945 period, and its contribution to the history of World War II and the post-war Army landscape.

Because technology has advanced so rapidly since the war, post-World War II properties were also given attention. These properties were evaluated in terms of the nation's more recent accomplishments in weaponry, rocketry, electronics and related technological and scientific endeavors. Thus the traditional definition of "historic" as a property 50

or more years old was not germane in the assessment of either World War II or post-war DARCOM buildings and structures; rather, the historic importance of all properties was evaluated as completely as possible regardless of age.

Property designations by category are expected to be useful for approximately ten years, after which all categorizations should be reviewed and updated.

Following this categorization procedure, Category I, II, and III historic properties were analyzed in terms of:

- Current structural condition and state of repair. This information was taken from the field inventory forms and photographs, and was often supplemented by rechecking with facilities engineering personnel.
- The nature of possible future adverse impacts to the property This information was gathered from the installation's master planning documents and rechecked with facilities engineering personnel.

Based on the above considerations, the general preservation recommendations presented in Chapter 3 for Category I, II, and III historic properties were developed. Special preservation recommendations were created for individual properties as circumstances required.

5. Report Review

Prior to being completed in final form, this report was subjected to an in-house review by Building Technology Incorporated. It was then sent in draft to the subject installation for comment and clearance and, with its associated historical materials, to HABS/HAER staff for technical review. When the installation cleared the report, additional draft copies were sent to DARCOM, the appropriate State Historic Preservation Officer, and, when requested, to the archeological contractor performing parallel work at the installation. The report was revised based on all comments collected, then published in final form.

NOTES

1. Historic American Buildings Survey/Historic American Engineering Record, National Park Service, Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures (unpublished draft, 1982).
2. Representative post-World War II buildings and structures were defined as properties that were: (a) "representative" by virtue of construction type, architectural type, function, or a combination of these, (b) of obvious Category I, II, or III historic importance, or (c) prominent on the installation by virtue of size, location, or other distinctive feature.
3. National Park Service, How to Complete National Register Forms (Washington, D.C.: U.S. Government Printing Office, January 1977).
4. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).

Chapter 2

HISTORICAL OVERVIEW

BACKGROUND

Redstone Arsenal, located near Huntsville, Alabama, is the headquarters of the U.S. Army Missile Command (MICOM), the major DARCOM subordinate command that manages the Army's missile and rocket program. Redstone's major responsibilities include research, development, procurement, and continued support of the Army's missile and rocket weapons systems. Occupying approximately 40,000 acres of land, the Arsenal's facilities include administrative buildings, laboratories, flight test ranges, and other specialized buildings and equipment. (Illustration 1)

Redstone Arsenal is also the location of the U.S. Army Missile and Munitions Center and School. Established on 1 December 1952, the school trains military and civilian personnel in the design, development, testing, and deployment of missiles and munitions.

The Thiokol Corporation is a major contractor that has operated government owned facilities at Redstone Arsenal since 1949. Thiokol is responsible for research, development, and production of solid propulsion systems. The GAF Corporation operates an iron carbonyl plant at Redstone Arsenal under a lease agreement with the Army.

NASA's George C. Marshall Space Flight Center (MSFC) is situated on 1,840 acres in the center of Redstone Arsenal (see separate section on MSFC).

NASA operates the facility under a special lease agreement with the Army.

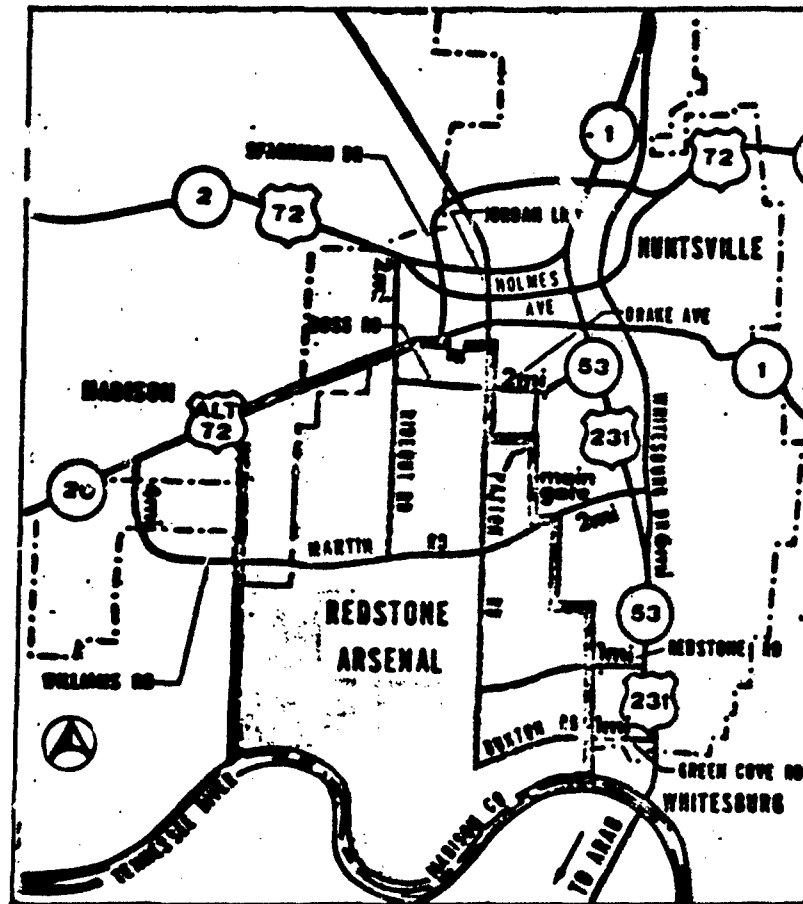


Illustration 1: Vicinity map of Redstone Arsenal. (Source: Environmental Office, Redstone Arsenal)

The present Redstone Arsenal was established in World War II as a chemical ammunition manufacturing center by the Chemical Corps and the Ordnance Corps of the U.S. Army. Originally known as the Siebert Arsenal Project, the center was located on the Tennessee River in northern Alabama. The Army acquired the site (approximately 37,000 acres of pastureland and farmland) in late 1941 and early 1942.

The center was built as three installations: the Huntsville Arsenal, the Redstone Ordnance Plant, and the Gulf Chemical Warfare Depot. The Huntsville Arsenal was located on the northwest side of the site and the Redstone Ordnance Plant in the southeast corner. The operation of both plants was closely integrated: the arsenal manufactured and loaded chemical ammunition shells, and the ordnance plant assembled the explosives and produced the completed rounds of chemical ammunition. The Gulf Chemical Warfare Depot, situated in the southern portion of the site near the Tennessee River, received, stored, and shipped chemical warfare materiel.¹

HUNTSVILLE ARSENAL: SITE DEVELOPMENT

In early 1941, the Edgewood Arsenal in Maryland was the Chemical Warfare Service's only chemical manufacturing installation. Because Edgewood had little room to expand, a site near Huntsville, Alabama, was chosen to serve as an extension of Edgewood for the manufacture of toxic agents, smoke, and incendiary materiel. The Army selected the Huntsville site because it was a large tract of land accessible to rail and river transportation and to electric power from the Tennessee Valley Authority.²

In July 1941, construction of the Huntsville Arsenal was authorized and land was acquired by condemnation proceedings. The War Department signed an architectural and engineering services contract with Whitman, Requardt, and Smith of Baltimore, Maryland, and construction contracts with C. G. Kershaw Contracting Co. of Birmingham, Alabama; Walter Butler Co. of St. Paul, Minnesota; and Engineers Limited of San Francisco, California. Col. Rollo C. Ditto was the first commanding officer and coordinated the planning and construction efforts.³

Initial plans for the installation called for 11 manufacturing plants and four chemical-loading plants. Storage facilities, laboratories, shop buildings, offices, housing, and a hospital were also included, as were the utilities and support services, including roads and railroads, necessary for the production, storage and shipping of chemical munitions.⁴ Principal manufacturing facilities planned for the Huntsville Arsenal included plants for the production of mustard gas, lewisite, phosgene, white phosphorous, iron carbonyl, white smoke munitions and incendiaries, tear gas, and colored smoke.⁵

Six mustard gas ("H") manufacturing plants were constructed at the arsenal in 1942. The first four plants were located in Area No. 1 and the other two in Area No. 2. Each plant consisted of a sulphur monochloride building, an ethylene generator building, and a mustard reactor building, and each was designed to produce 24 tons of mustard gas per day, with a maximum capacity of 40 tons per day. All plants were in operation by the end of 1942, but most were operated for less than one year. Production of mustard gas officially ceased at Huntsville Arsenal on May 28, 1943. (Illustrations 2-4)

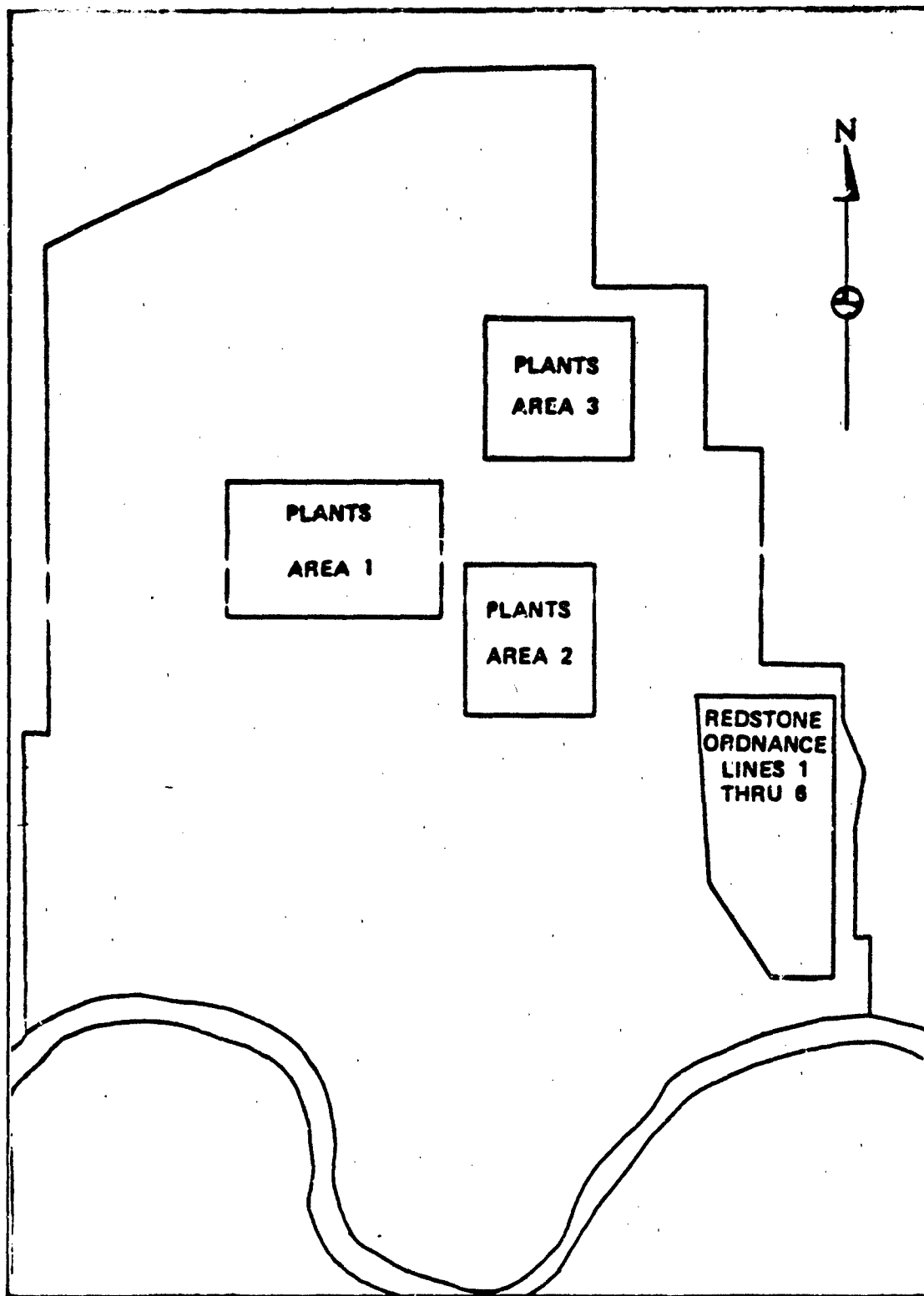


Illustration 2: Map showing World War II locations of Huntsville Arsenal Manufacturing and Loading Plants Areas 1-3, and Redstone Ordnance Line 1-6. (Source: Environmental Office, Redstone Arsenal)

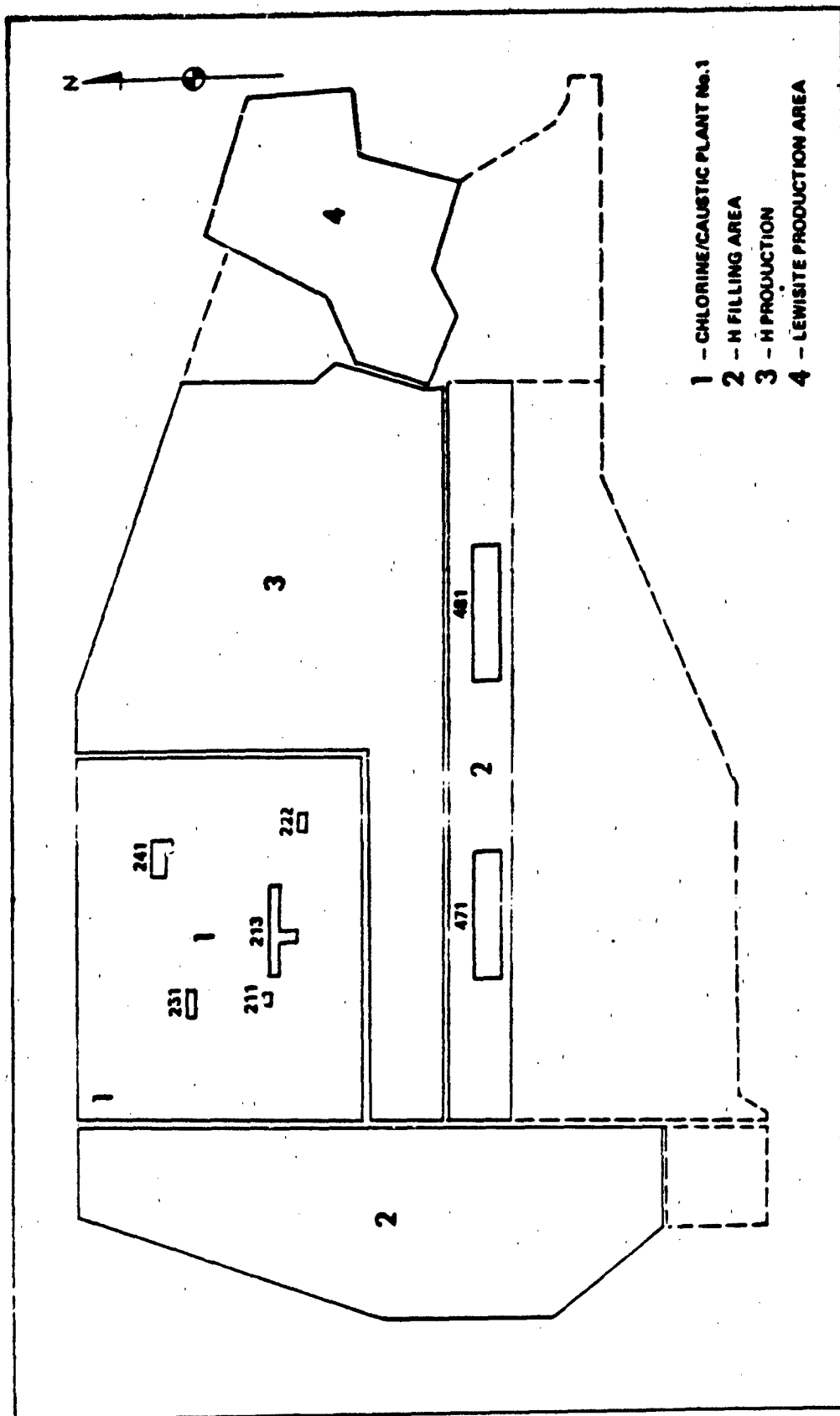


Illustration 3: Location of World War II facilities within Huntsville Arsenal Plant No. 1. (Source: Environmental Office, Redstone Arsenal)

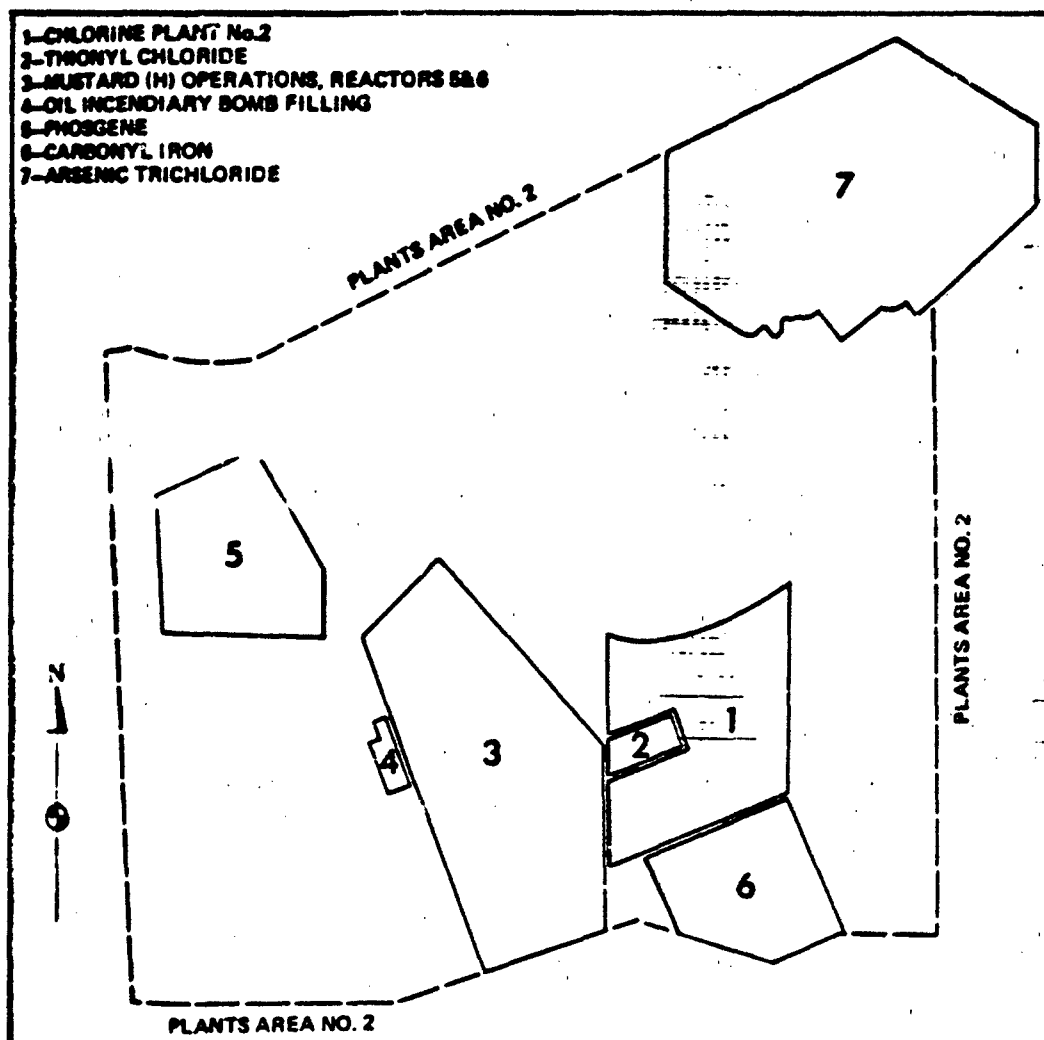


Illustration 4: Location of World War II facilities within Huntsville Arsenal Plants Area No. 2. (Source: Environmental Office, Redstone Arsenal)

Two chlorine plants constructed in 1942 supported the production of mustard gas. The plants, one in Area No. 1 and the other in Area No. 2, could produce either liquid or gaseous chlorine, a necessary ingredient for the manufacture of mustard gas. Both plants operated from May 1942 to July 1945.

Two mustard gas filling plants, located in Area No. 1, were completed in early 1942. The first items produced in these plants were 105-mm M60 shells. Production began in April 1942 and continued until March 1944, when both plants were placed on standby. The plant in Area No. 2 was reactivated later on two separate occasions.

Originally, Huntsville Arsenal was intended to have six lewisite plants, but only four plants were actually operated during World War II. (Plants No. 5 and 6 were completed except for minor items of equipment, but neither plant was activated.) These four plants were all operable by May 1943. Two plants stood in Area No. 1, and two in Area No. 2. The plants ceased operation in October 1943, when the Huntsville Arsenal permanently halted the manufacture of lewisite. Two other facilities, a thionyl chloride plant and an arsenic trichloride plant, produced products necessary for the manufacture of lewisite. Both plants were located in Area No. 2; the chloride plant was operational from March to October 1943, and the arsenic plant was operational from March to November 1943.

Huntsville Arsenal's only phosgene plant, located in Area No. 2, operated from February 1944, to January 1945. The facility included a carbon monoxide generating plant, a container filling shed, a catalyzer building, various

storage tanks, and an office building. A phosgene filling plant situated immediately adjacent to this complex had six filling stations, each capable of filling 40 bombs per eight hour shift. The plant filled 500-pound M78 bombs from 15-17 April 1944, and 1,000-pound M79 bombs from 27 April until the supply of phosgene was depleted on 17 January 1945.

A white phosphorus filling plant occupied a site on the west side of Area No. 1. Between May 1942 and August 1945, this plant filled ten different munitions, including artillery and mortar shells, grenades, and igniter tubes.

During World War II, Huntsville Arsenal also produced M4 white smoke pots, two types of tear gas grenades and four types of incendiary oil munitions, and colored smoke for grenades and canisters. An iron carbonyl plant at the arsenal served as a standby plant. This facility, located in Area No. 2, has been operated by the GAF Corporation since 1949.

Following V.J. Day, Army activities at the Huntsville Arsenal were curtailed. The arsenal was designated a storage center for vast amounts of war reserve materiel. In 1946, chlorine manufacturing plants No. 1 and 2 were leased for five years to the Solvay Process Division of Allied Chemical and Dye Corporation. The Keller Motors Corporation took a fifteen year lease on facilities to manufacture gas masks, and the Calabma Chemical Company took a fifteen year lease on facilities to manufacture organic chemicals, insecticides, and related products.⁶

In 1947, the Department of the Army declared the Huntsville Arsenal surplus to the needs of the Army. The chief of the Chemical Corps reversed this

decision in 1948 and placed the arsenal on "standby" status. Early in 1949, the decision was again reversed and the arsenal was placed for sale. Plans were made to ship serviceable supplies to other installations, demilitarize unserviceable chemical materiel, dispose of property through sale or salvage, and decontaminate production lines. Redstone Arsenal, acting in a caretaker capacity, provided security and maintained essential utilities. In April 1950, Huntsville Arsenal was completely deactivated and was transferred from the Chemical Corps to Army Ordnance. Its facilities were consolidated with those of Redstone Arsenal.⁷

GULF CHEMICAL WARFARE DEPOT: SITE DEVELOPMENT

The operations of the Huntsville Arsenal and the Gulf Chemical Warfare Depot closely intertwined. Of the nearly 33,000 acres comprising the original Huntsville Arsenal, approximately 8,000 were planned as a depot site. This acreage was located in the southern portion of the arsenal along the Tennessee River. In March 1942, the depot was activated as a separate installation, known as Huntsville Chemical Warfare Depot. Its name changed in August 1943 to the Gulf Chemical Warfare Depot. In August 1946, the word "Warfare" was dropped from this title.

The depot received, stored, and shipped chemical warfare materiel, including bulk chemicals, decontaminating apparatus, and protective materials. It covered nearly twelve square miles and was divided into three principal areas: the toxic gas yard, the munitions branch, and the warehouse area. All were in operation by October 1942. By early 1943, the depot consisted of seven warehouses, 370 igloos, 55 above-ground magazines, several outdoor

storage areas, twelve miles of railroad track, and dock facilities on the Tennessee River.⁸

In January 1947, the Gulf Chemical Depot was abolished as a separate entity and its functions transferred to the Huntsville Arsenal.

REDSTONE ORDNANCE PLANT: SITE DEVELOPMENT

The Army erected the Redstone Ordnance Plant as a chemical ammunition assembly plant on a site adjacent to the Huntsville Arsenal. The original layout included two burster-loading assembly lines and two chemical ammunition assembly lines. Storage facilities, administrative facilities, housing, and utilities were also built.⁹ (Illustrations 2 and 5)

Production Line No. 1 was scheduled for completion first, but due to construction delays, Production Lines No. 1 and 2 were constructed simultaneously. Both lines, completed by 1942, loaded and assembled burster tubes. The loading plants at Redstone were designed to utilize the cast method. This process, developed at Picatinny Arsenal in 1941, centers on forming the explosive tetrytol into predetermined shapes and sizes for later use. (Illustrations 6-7)

Production Lines No. 3 and 4 were completed in April and August of 1942, respectively. These lines loaded and assembled chemical ammunition. All major ammunition components, such as cartridge cases and empty shells, came from private manufacturers. Other Army ordnance plants produced minor components such as fuses, boosters, propellant charges, and primers.

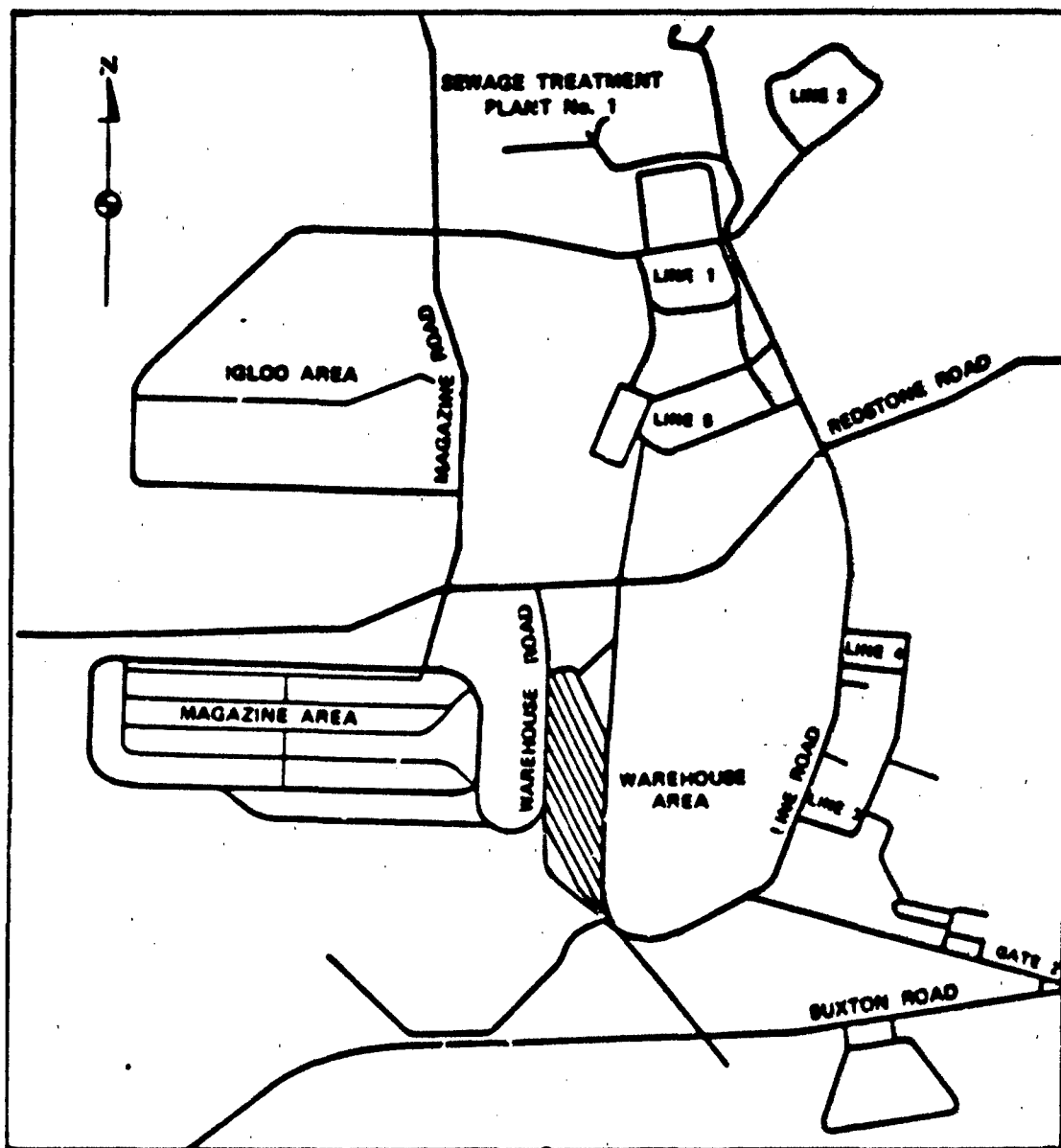


Illustration 5: Area map of the Redstone Ordnance Plant during World War II, showing location of Redstone Ordnance Lines 1-6. (Source: Environmental Office, Redstone Arsenal)

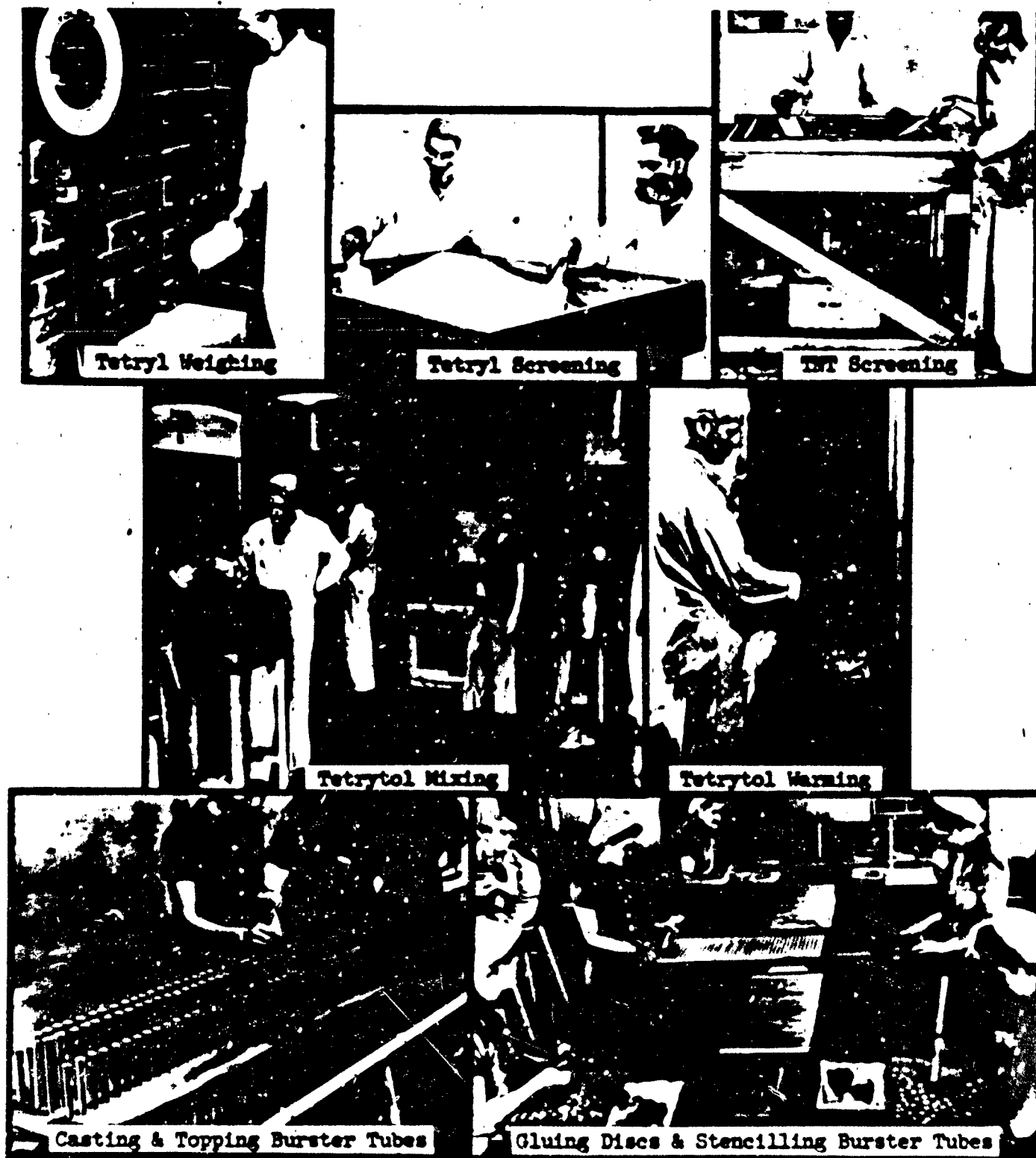


Illustration 6: Operations at Redstone Ordnance Line 1 during World War II consisted of mixing, melting, and pouring the explosive tetrytol in the manufacture of burster charges. (Source: Historian's Office, Redstone Arsenal)



Illustration 7: Operations at Redstone Ordnance Line 2 during World War II consisted of mixing, melting, and pouring the explosive tetrytol in the manufacture of demolition blocks and burster charges. (Source: Historian's Office, Redstone Arsenal)

which were shipped to Redstone for loading and assembly. After inspecting and testing the components, Redstone sent the empty shell and burster casing to the Huntsville Arsenal. Here the shells were filled with the appropriate chemicals, sealed, and returned to Redstone for assembly into complete rounds of chemical ammunition. (Illustration 8)

The first four production lines at the Redstone Ordnance Plant were essentially completed by the summer of 1942. A fifth production line, designed to assemble 155-mm shells and chemical bombs, was constructed in August 1942 and was ready for production by January 1943.¹⁰ (Illustration 9)

In February 1943, the plant's name changed to the Redstone Arsenal, and in January 1945, the arsenal announced an expansion program costing \$5.5 million. This program, essentially completed by V. J. Day, greatly expanded production output. A melt-pour building, two screening and storage buildings, and a change house added to Production Line No. 1 increased production on this line to 200,000 pounds of tetrytol bursters per month. Additions to Production Line No. 2 included three production buildings, storage facilities, and related utilities. Alterations to Line No. 3 included new buildings for reprocessing ammunition, paint storage, and the extensive renovation of existing buildings to adapt the line to the mechanized assembly of 105-mm shells. Additions to Line No. 4 increased production capacity to 650,000 rounds of 81-mm chemical mortar shells per month, and changes to Production Line No. 5 more than tripled the production capacity for 155-mm chemical shells — from 58,000 to 190,000 projectiles per month. Also included in the expansion program were plans for a sixth production line to handle assembly of 81-mm



Illustration 8: Operations at Redstone Ordnance Line 3 during World War II included the assembly of complete rounds of chemical ammunition. (Source: Historian's Office, Redstone Arsenal)



Taping Fiber Containers

Inserting Cartridges & Clips

Sealing & Strapping Boxes

Illustration 9: Operations at Redstone Ordnance Line 5 during World War II included the assembly and packaging of ammunition and chemical bombs. (Source: Historian's Office, Redstone Arsenal)

chemical mortar and 105-mm howitzer chemical shells. This line was constructed but never used.¹¹

Activity at the Redstone Arsenal slowed rapidly following V.J. Day. Production of ammunition ceased on 17 August 1945. The Army decontaminated production lines and placed them on standby status. Renovation and salvage of wartime materiel continued until February 1947 when the Redstone Arsenal was placed on standby status.

In 1949, the Government contracted with the Rohm and Haas Company of Philadelphia and the Thiokol Corporation of Trenton, New Jersey, to perform research on rocket propellants. Both companies occupied space in the vacant production line facilities at Redstone Arsenal.¹²

The Chief of Ordnance reactivated Redstone Arsenal in June 1949 to serve as a center for research and development in the field of rocketry. In July, the Army officially announced that the rocket program at the Ordnance Research and Development Division in Fort Bliss, Texas would be moved to Redstone. With the arrival in 1950 of 120 German scientists, headed by Dr. Wernher von Braun, and a complement of officers from Fort Bliss, the Ordnance Guided Missile Center was established at Redstone and the arsenal entered the missile era.

REDSTONE ARSENAL: 1949 - PRESENT

Redstone Arsenal's first mission after its reactivation in 1949 centered on rocket-related research and development. This included basic and applied research, development and testing of free rockets, jet-assisted take-off engines

(JATO's), solid propellant fuels, and other related items. With the arrival of the von Braun group in 1950, Redstone became responsible for the research and development of guided missiles. The arsenal's research program later expanded to include anti-aircraft rockets, rocket launchers, aerial tow targets, and liquid and solid propellant rocket fuels, liquid oxygen and other industrial gases.¹³

Rocket research and development activities were located in the old Redstone Arsenal area in the southeast corner of the site. Guided missile research and development activities were conducted in the chemical plant areas and the headquarters area of the former Huntsville Arsenal. In September 1952, both centers were combined to form the Ordnance Missile Laboratories. The OML served as the principal source of technical information on rockets within the Ordnance Department.

In July 1950, Redstone Arsenal was directed to develop a 500-mile surface-to-surface missile which later became known as the REDSTONE missile. The Arsenal fabricated and assembled the first twelve prototypes from components supplied by private industry. The Chrysler Corporation received the first industrial contract for the REDSTONE missile in June 1955.

In addition to the REDSTONE, the arsenal also had varying degrees of responsibility for several other projects, including the NIKE AJAX, CORPORAL, HERCULES, HAWK, DART, LACROSSE, PLATO and SERGEANT missiles, as well as the HONEST JOHN, LOKI, and LITTLEJOHN rockets.

The U.S. Army Ordnance Guided Missile School, established at Redstone in 1952, trained military and civilian personnel in the handling and maintenance

of rockets and guided missiles. The Ordnance School gave instruction in missile design, development, testing, and prototype manufacture. The school also provided instruction in the development of maintenance programs, training courses, and deployment procedures. It still occupies 139 buildings on 375 acres in the northeast corner of the installation and uses an additional 3,310 acres for outdoor training purposes.

In February 1956, the newly created Army Ballistic Missile Agency (ABMA) took over responsibility for the REDSTONE missile. The REDSTONE was deployed to NATO forces in 1958, thus becoming the first of the large U.S. ballistic missile systems to become operational. The ABMA was placed under the Army Ordnance Missile Command in March 1958. This command managed all aspects of fifteen major weapon systems, from research and development to production, storage, and maintenance.

The Development-Operations Division of ABMA and about \$100,000 of equipment from Redstone Arsenal and Cape Canaveral were transferred in July 1960 from the jurisdiction of the Army to the National Aeronautics and Space Administration (NASA) and renamed the George C. Marshall Space Flight Center. It now occupies 1,840 acres in the center of the arsenal on a lease arrangement from the Army.¹⁴

In August 1962, the Army Ordnance Missile Command was redesignated the U.S. Army Missile Command (MICOM), which today has jurisdiction over the remainder of the Redstone Arsenal.

MARSHALL SPACE FLIGHT CENTER: BACKGROUND

A Presidential Executive Order in 1960 established the George C. Marshall Space Flight Center to support a national program for the exploration of space. The new center designed and developed large launch vehicles and rocket propulsion systems. Initial efforts concentrated on the Juno, Saturn, and Centaur launch vehicles, the development of the Agena B stage for the Atlas-Agena B and Thor-Agena B booster rocket engines, the supervision of the F-L single engine program, and the development of the Mercury-Redstone vehicle for NASA's Project Mercury.¹⁵

During the 1960's, the center developed Saturn launch vehicles. The Saturn I was the launch vehicle for the Pegasus meteoroid detection satellites. The Saturn I-B was used for Apollo spacecraft development and orbital maneuvers, and for the Skylab and Apollo-Soyuz Test Project missions. The Saturn V was the launch vehicle for the Earth orbital missions, which included the Lunar Lander, Lunar Rover Vehicle, and Skylab missions.¹⁶

The Marshall Space Flight Center is currently one of NASA's primary facilities for the design and development of space transportation systems, orbital systems, and scientific and applications payloads for space exploration. The center also has responsibility for rocket propulsion systems mission management, space processing payload projects, and solar heating and cooling assignments in support of the Department of Energy.

MARSHALL SPACE FLIGHT CENTER:

DESCRIPTION OF MAJOR FACILITIES

The extensive complex of scientific equipment and facilities at the Marshall Space Flight Center constitutes one of the most complete aerospace research and development centers in the world. Facilities range from standard scientific laboratories to several nationally unique and highly-specialized laboratory facilities such as The Neutral Buoyancy Simulator, The Acoustic Model Engine Test Facility and the Structural Dynamics Test Facility. The test stands and high-bay spaces at the center can accommodate space system components through all stages of development and flight readiness testing.¹⁷ (Illustration 10)

The Redstone Rocket Test Stand (Building #4665) was built in 1953 and was operational until 1973. It was listed on the National Register of Historic Places in 1976. The test stand, which is a steel-frame structure 75' tall, is the oldest static firing facility at the Marshall Space Flight Center. It was constructed by the Ordnance Guided Missile Center at Redstone Arsenal and was transferred to NASA in 1960. It was the first test stand in the United States to accommodate the entire launch vehicle for static tests (previous test stands in this country had accommodated the engine only) and was an important facility in developing the JUPITER C and the MERCURY-REDSTONE vehicles that launched the first American satellite and the first American manned spaceflight. The test stand was also used to develop the "manrated" launch procedures vital to manned space flights and the acceptance firing criteria which were later adapted as standard launch procedure. Technical advances were made in launch pneumatics, thrust measurement, propellant fuel procedures, and launch ignition procedures during various tests at this facility.¹⁸ (Illustration 11)

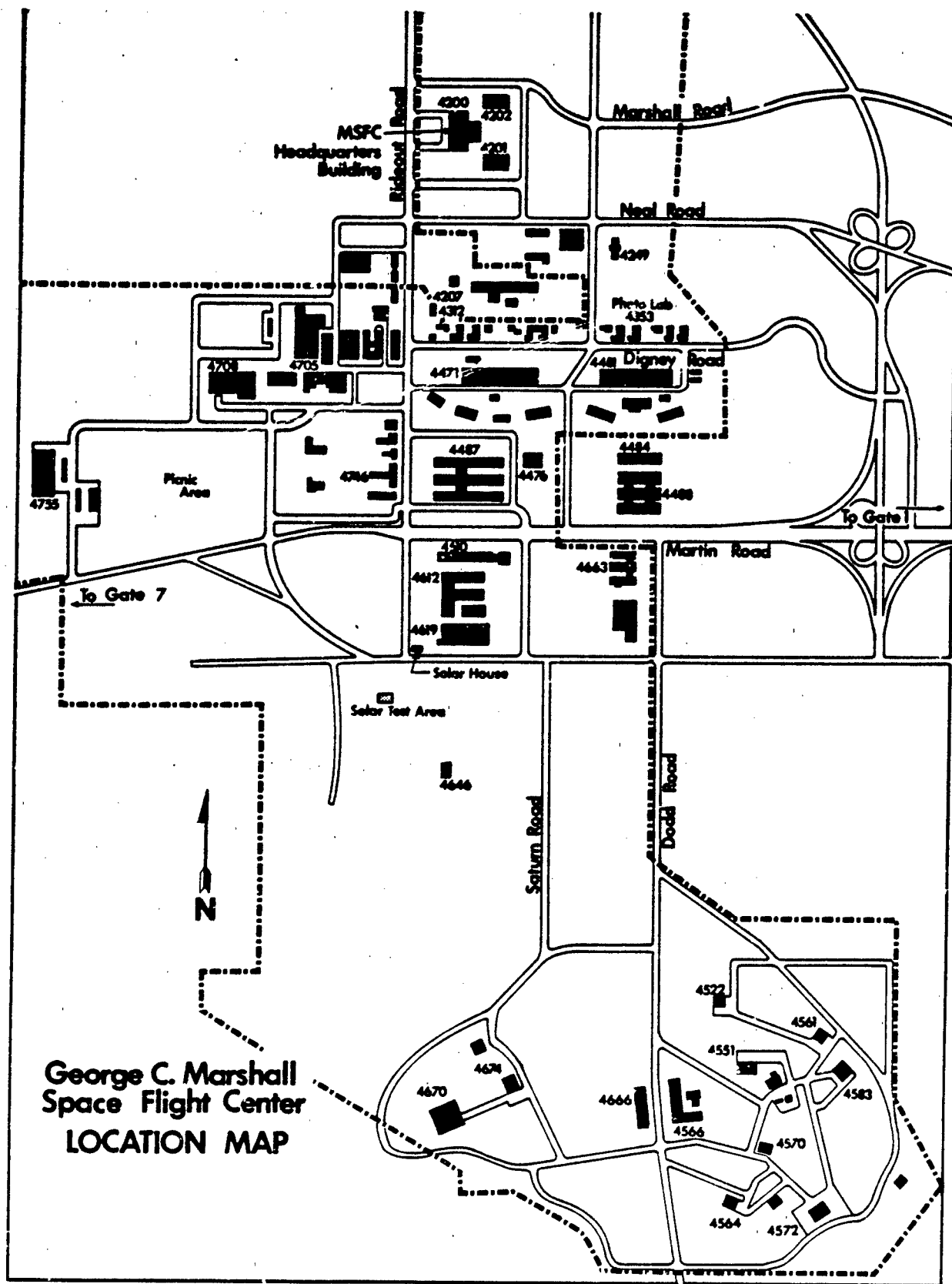


Illustration 10: George C. Marshall Space Flight Center location map. (Source: Master Planning Office, Marshall Space Flight Center)

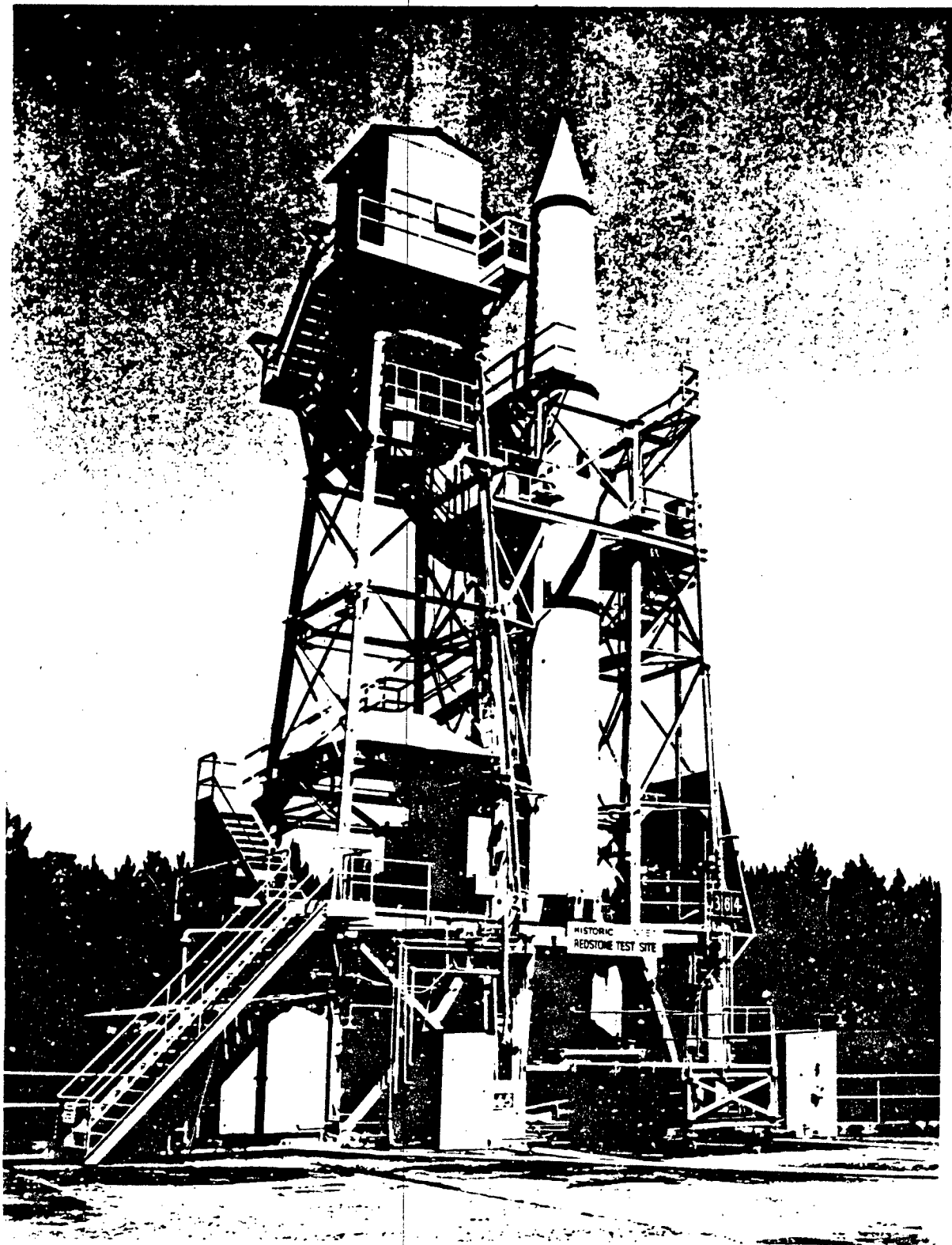


Illustration 11: The Redstone Rocket Test Stand Historic Structure at NASA's Marshall Space Flight Center. (Source: Field inventory photograph, 1983, David G. Buchanan, Building Technology Incorporated)

The Neutral Bouyancy Simulator (Building #4705), built in 1955, provided a simulated zero-gravity environment in which engineers, designers, and astronauts could test the operational characteristics of equipment under zero-gravity conditions. A large water tank, 75' in diameter and 40' deep, simulated the various phases of space flight. The 1.5 million gallon tank has four observation levels and special systems for underwater audio and video communication. Life support systems allow up to four persons to use the facility at one time.

The Solid Rocket Motor Propulsion and Structural Test Facility (Building #4572), constructed in 1957, is located in the East Test Area. Designed to gauge the strength capabilities of various rocket motors, the facility was used in the Saturn/Apollo program for testing the booster stage of the Saturn S-1B vehicle and the F-1 engine of the booster stage of the Saturn S-1C vehicle. It can structurally accommodate propulsion systems with thrust levels of up to 1.6 million pounds. The twin rocket motor propulsion test stand is 145' high and 30' by 20' at the base. It is equipped with a 100-ton overhead crane and a 45-ton gantry crane (Building #4573). Control and instrumentation are provided by the East Area Blockhouse and Cable Tunnels (Building #4570), with connections to the computer-controlled data acquisition system in the Structures and Mechanics Laboratory. (Illustrations 12-13)

The Structures and Mechanics Laboratory (Building #4619) was built in 1959. Test facilities include large high-bay and low-bay areas for the static and dynamic structural testing of large and small components of space vehicles

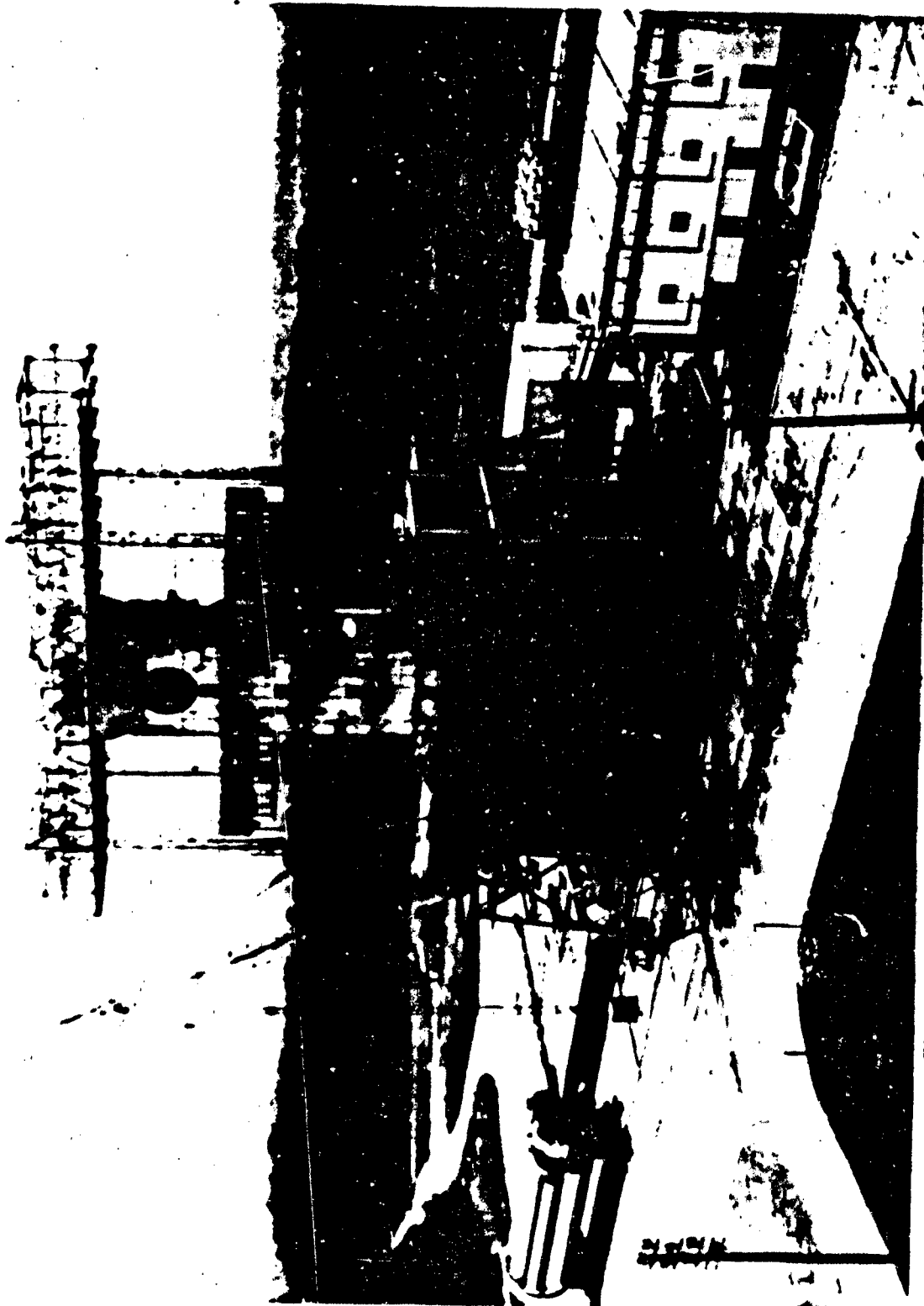


Illustration 12: View looking south of the Solid Rocket Motor Propulsion and Structural Test Facility (Building 4572) at NASA's Marshall Space Flight Center. (Source: Master Planning Office, Marshall Space

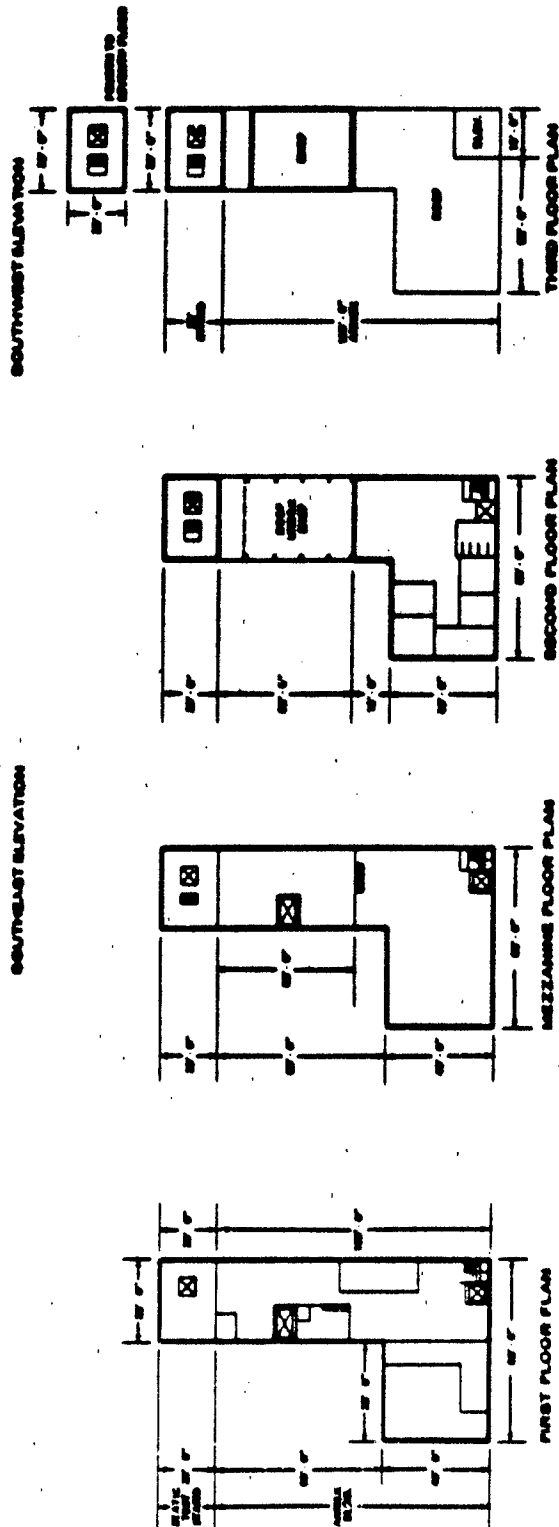
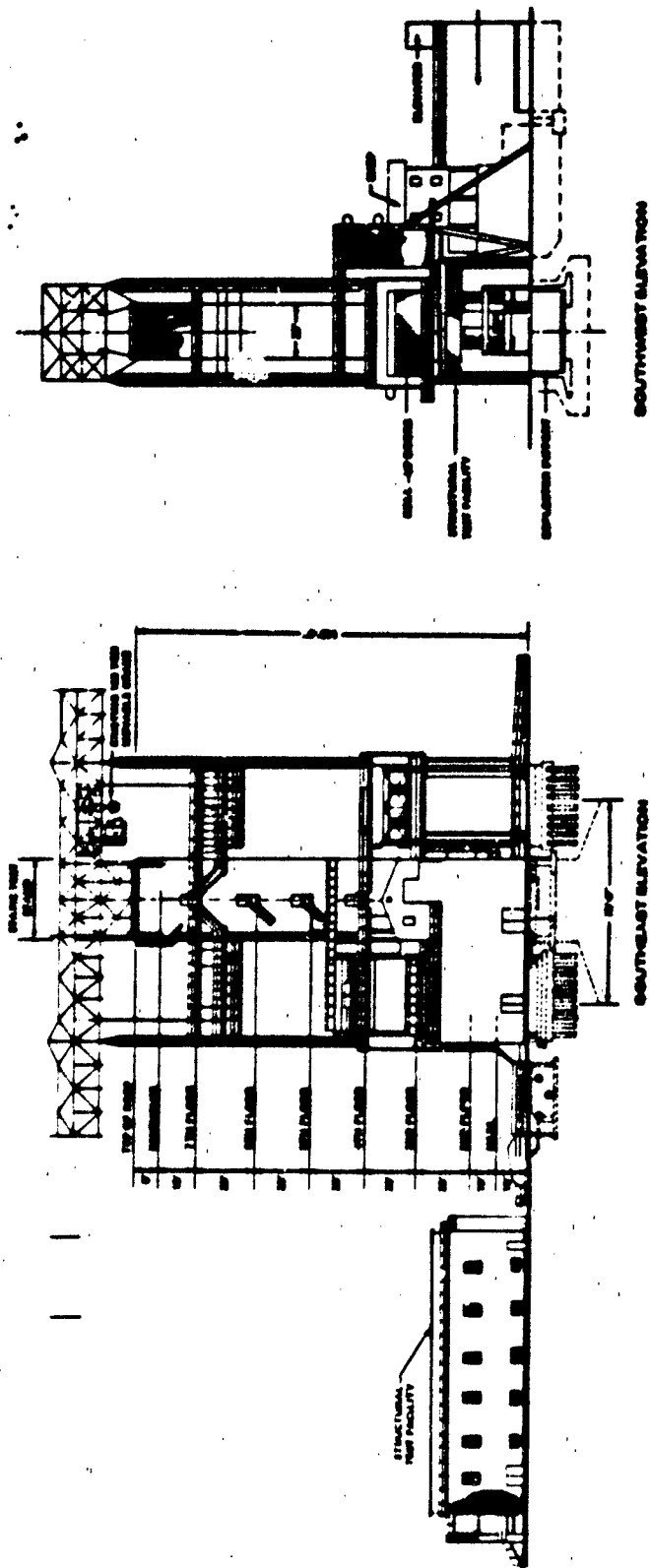


Illustration 13: Elevation and plan drawings of the Solid Rocket Motor Propulsion and Structural Test Facility (Building 4572) at NASA's Marshall Space Flight Center. (Source: Master Planning Office, Mar-

or payloads. Test systems within the laboratory are linked to remote test sites by cable systems or by the Space Flight Center's communication system. A major component of the laboratory is the Structural Test Tower, which has a 3 million pound universal testing machine with capacity for both lateral and vertical load testing.

The Acoustic Model Engine Test Facility (Building #4540), built in 1964, tests scale models of space vehicles. Small-scale liquid hydrogen and liquid oxygen rocket engines with chamber pressure ratings of up to 5,000 psi can be fired in the facility, which includes an Open Steel Test Stand Structure, a Mechanical Preparation Shop (Building #4539), and an Electrical Control and Acoustic Data Acquisition Center (Building #4541). A total of 148 acoustic measuring stations are distributed over a large semi-circular blacktop area around the test stand. Acoustic measuring stations are also located on the structure itself. These measuring devices are used to record data during propulsion systems testing.

The Structural Dynamics Test Facility (Building #4550), built in 1964, can test very large vehicles under dynamic load situations similar to those experienced at launch and during flight. The vehicle rests on hydrodynamic supports that provide a maximum of 6 degrees freedom of movement. Vibration loads can be induced in the pitch, yaw, or longitudinal axis to obtain resonance frequencies and bending modes. The performance of vertical mating features between stages can also be investigated. The test stand is 360' high and 122' by 98' at the base. It has a maximum center bay size of 74' by 74', and has a main derrick at the top of the structure capable of handling 200

tons at a 70' radius. The facility is connected by a cable tunnel to the east area Blockhouse (Building #4570). (Illustrations 14-15)

The Propulsion and Structural Test Facility (Building #4670), located in the West Test Area, built in 1965, can accommodate propulsion systems testing up to 12 million pounds thrust and was originally constructed to test the Saturn S-1C booster stage engine at a thrust rating of 7.5 million pounds. The facility is capable of applying structural test loads to vehicles as long as 170' and as large as 40' in diameter. The test stand is 266' high and stands on four concrete piers, each 48' by 48'. It has two derricks, a 200-ton capacity derrick at the top of the structure and a 150-ton capacity derrick at the 94' level. A wind barrier encloses the test stand and provides a relatively protected environment as high as 130' above the base of the structure. Access platforms with working levels every ten feet extend to 112' above the base of the structure. Hydraulic and pneumatic gas systems are remotely controlled from the Test Control Center Blockhouse (Building #4674). Data acquisition on 8,000 instrumentation channels is available at the blockhouse. (Illustrations 16-17)

The Barge Dock Facility (Building #8037) was constructed in 1966 for shipping large space components that cannot be moved by conventional highway, rail, or air transport. The two concrete docks are located at the River Terminal of Redstone Arsenal on the Tennessee River. They are specially designed to accommodate the barges used to transport the Saturn I and Saturn V components from Marshall Space Flight Center to the Kennedy Space Center at Cape Canaveral, Florida. (Illustration 18)



Illustration 14: View looking south of the Structural Dynamics Test Facility (Building 4550) at NASA's Marshall Space Flight Center. In the background are two other test facilities (Buildings 4557 and 4588). (Source: Master Planning Office, Marshall Space

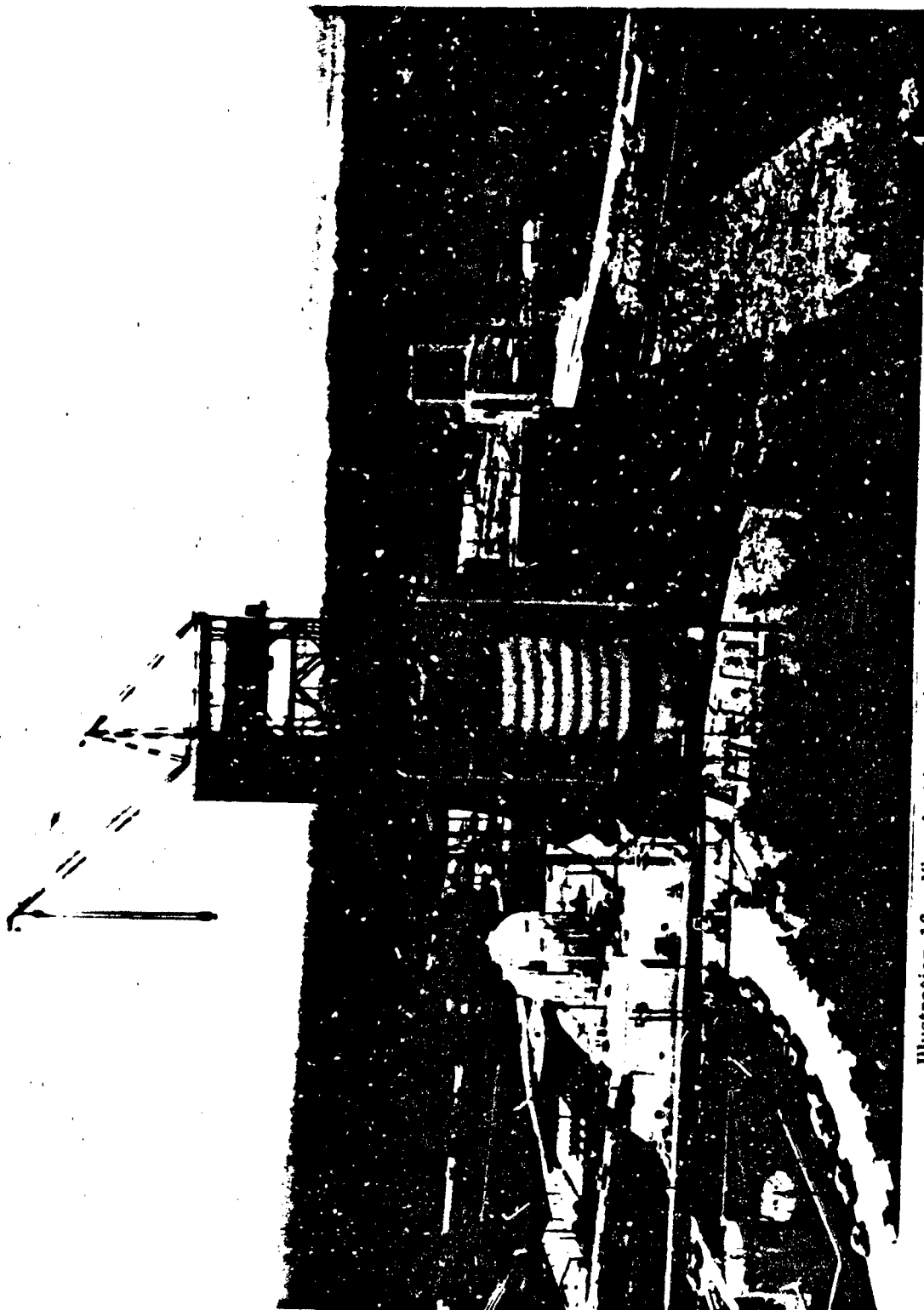


Illustration 16: View looking south of the Propulsion and Structural Test Facility (Building 4670) in the West Test Area of NASA's Marshall Space Flight Center. (Source: Master Planning Office, Marshall Space Flight Center)

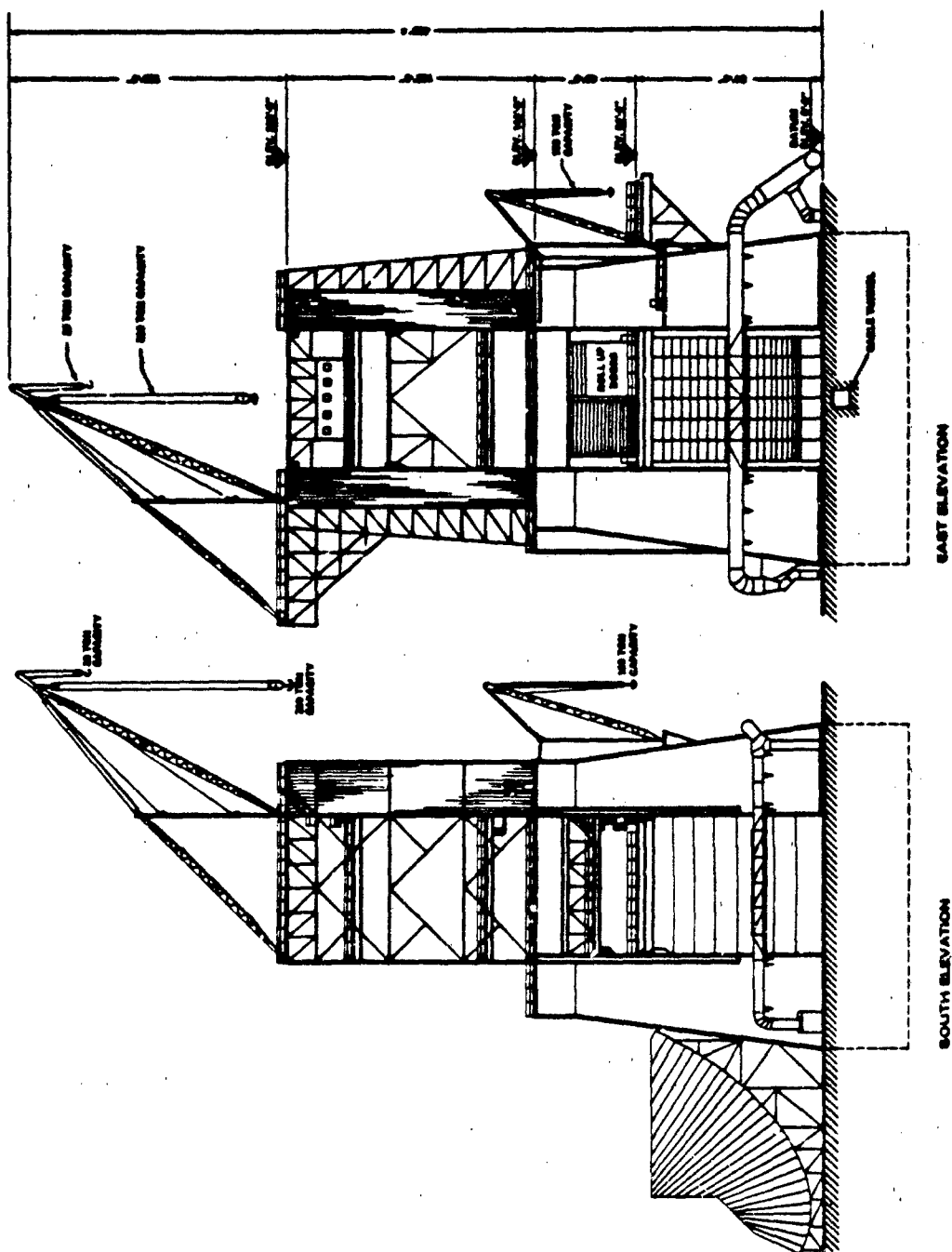


Illustration 17: Elevation drawings of the Propulsion and Structural Test Facility (Building 4670) at NASA's Marshall Space Flight Center. (Source: Master Planning Office, Marshall Space Flight Center)

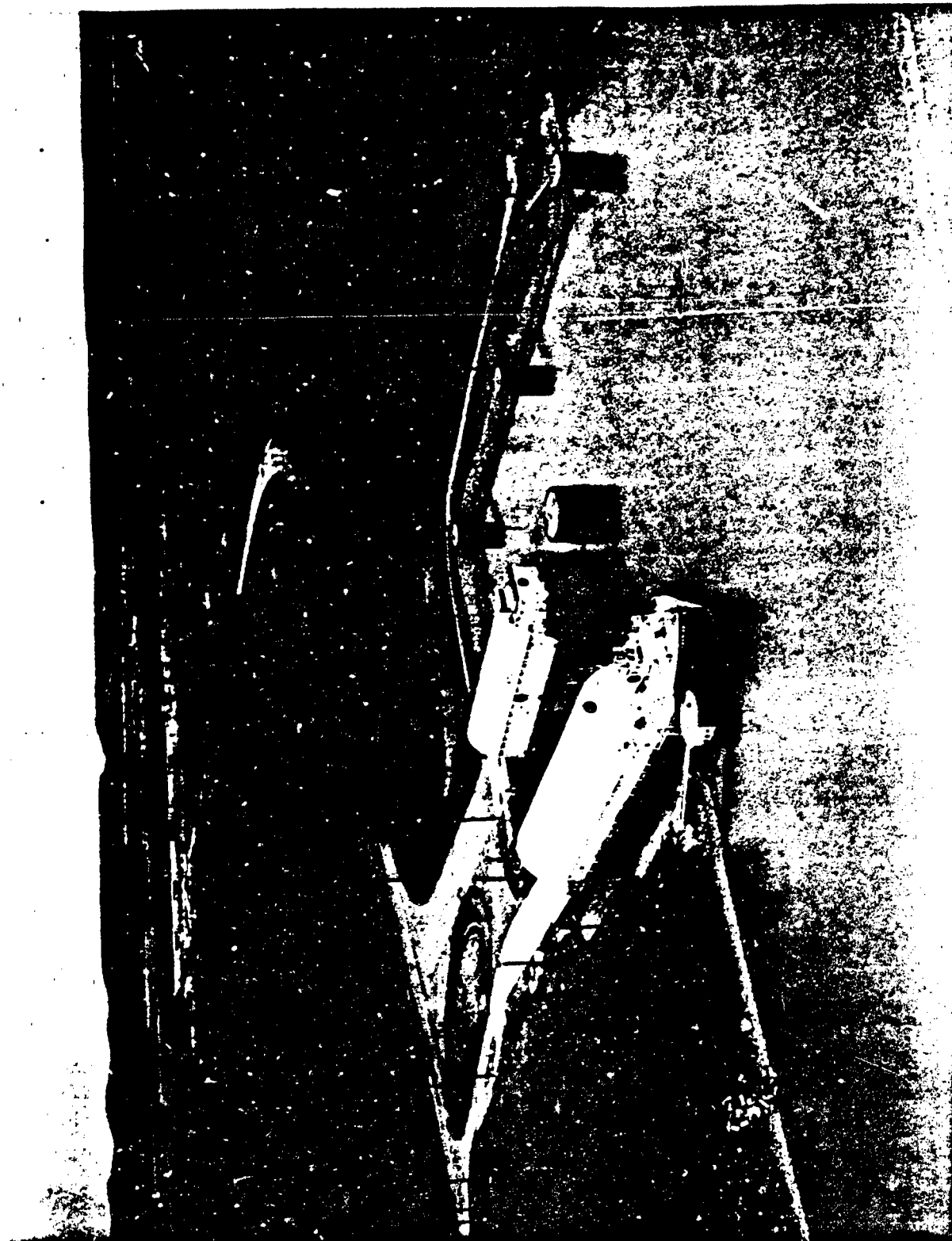


Illustration 18: View looking north of NASA's Barge Dock Facility (Building 8037) on the Tennessee River in Redstone Arsenal. (Source: Master Planning Office, Marshall Space Flight Center)



Illustration 19: View looking northeast of the Administrative Complex (Buildings 4200-4202) at NASA's Marshall Space Flight Center. (Source: Master Planning Office, Marshall Space Flight Center)

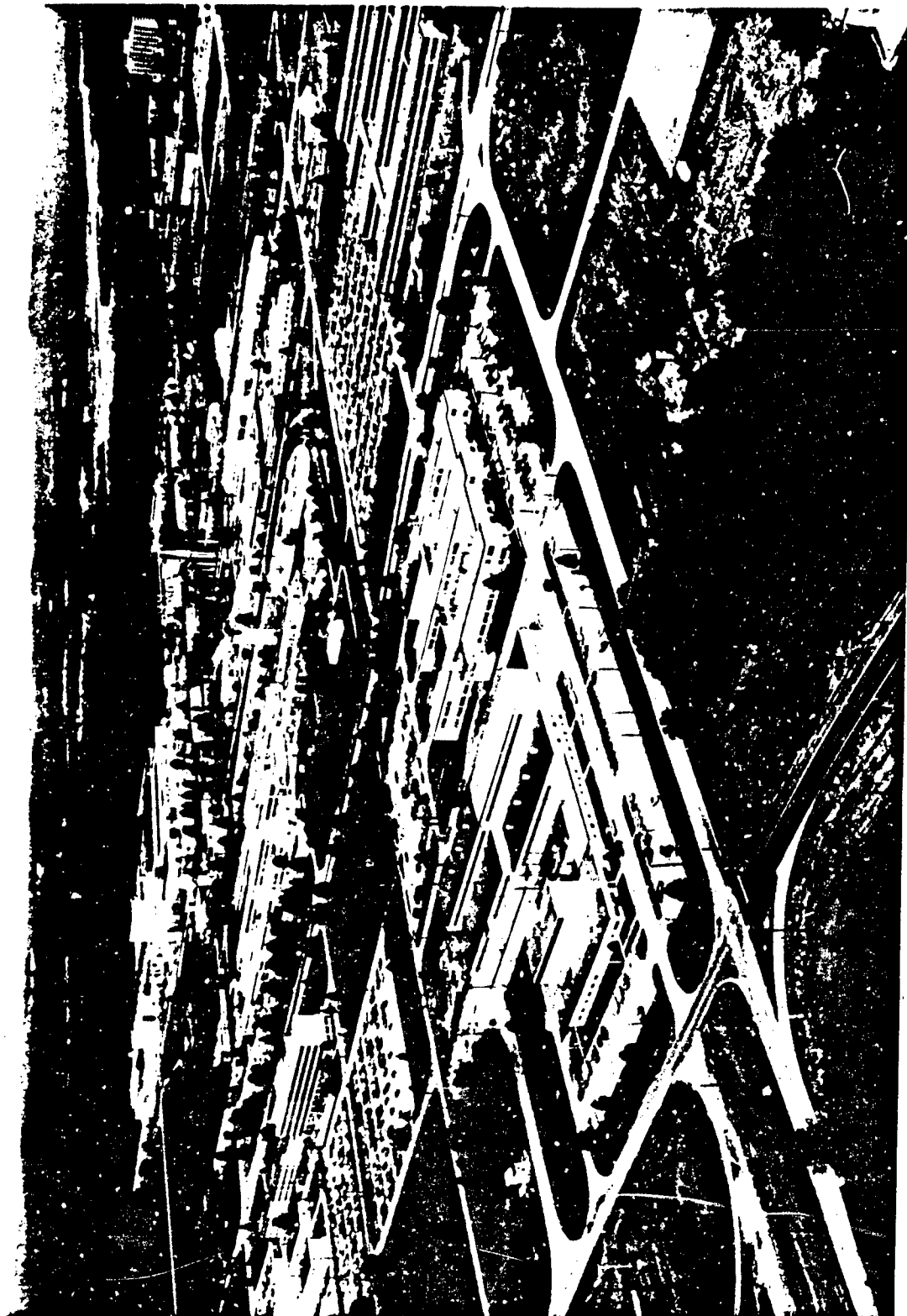


Illustration 20: View looking northwest of the laboratories, high-bay facilities, and administrative buildings at NASA's Marshall Space Flight Center. (Source: Master Planning Office, Marshall Space Flight Center)

The High Reynolds Number Wind Tunnel Facility (Building #4775), built in 1968, can generate winds in the subsonic, transonic, and supersonic ranges up to Mach 3.5. Its Reynolds number test capability in the critical transonic range is higher by a factor of four than any other wind tunnel in the nation. Primary components of the facility include a long constant diameter supply tube, a stilling chamber, six interchangeable nozzles, two interchangeable test sections, a model support system, a diaphragm section, a receiver sphere, and a 40-channel computer-controlled data acquisition system.

The Marshall Space Flight Center has numerous other laboratory buildings, high-bay hangar-type facilities, and administrative buildings, some of which were originally a part of the Huntsville Arsenal. The main administrative area was built by NASA in 1963 and includes a 10-story building (Building 4200) and two 6-story buildings (Buildings 4201-4202) that are situated on a hillside overlooking the center's laboratories and test stands. (Illustrations 19-20)

NOTES

1. U.S. Army Missile Command, Redstone Arsenal (Redstone Arsenal, Alabama: DARCOM, Installation and Activity Brochure, 1981), pp. 1-6; see also This is DARCOM, p. 29.
2. Leo P. Brophy and George J. B. Fisher, The Chemical Warfare Service: Organizing for War (Washington, D.C.: U.S. Army Office of Military History, 1959), pp. 37 and 120-122.
3. Leo P. Brophy, Wyndham P. Niles, and Rexmond C. Cochrane, The Chemical Warfare Service: From Laboratory to Field (Washington, D.C.: U.S. Army Office of Military History, 1959), pp. 256-258, 277, and 343.
4. Helen Brents Joiner, The Redstone Arsenal Complex in the Pre-Missile Era: A History of Huntsville Arsenal, Gulf Chemical Warfare Depot, and Redstone Arsenal, 1941-1949 (Redstone Arsenal, Alabama: Army Missile Command, Historical Division, 1966), p. 4.

5. Joiner, Pre-Missile Era, pp. 27-41; also U.S. Army Toxic and Hazardous Materials Agency, Installation Assessment of Redstone Arsenal, Report No. 118 (Aberdeen Proving Ground, Maryland), pp. II-1 - II-5. The description of chemical munitions manufacture at Huntsville Arsenal in World War II that follows is taken from these sources.
6. Joiner, Pre-Missile Era, pp. 69; 74.
7. Ibid, pp. 75-87.
8. Ibid, pp. 58-65.
9. Ibid, pp. 102-107; also Installation Assessment of Redstone Arsenal, p. II-5. The description of production lines at Redstone Arsenal during World War II that follows is taken from these sources.
10. Joiner, Pre-Missile Era, p. 101.
11. Ibid, pp. 123-128.
12. Ibid, pp. 132-133.
13. Helen Brents Joiner and Elizabeth C. Jolliff, The Redstone Arsenal Complex in Its Second Decade, 1950-1960 (Redstone Arsenal, Alabama: Army Missile Command, Historical Division, 1969), pp. 5-10; also Activity Brochure, pp. 1-2. This brief summary of activities at Redstone Arsenal from 1950 to the present is derived from these sources.
14. Department of Defense and National Aeronautics and Space Administration, "Army-NASA Transfer Plan," (Unpublished Agreement, December 11, 1952), pp. 1-4 and 11-17.
15. For pre-1960 Army activities in space see Ernst Stunliger, "Army Activities in Space - A History," Institute of Radio Engineers, IRE Transactions on Military Electronics, Vol. 49-4, No. 2-3, April-July 1960 and Wernher von Braun, "The Redstone, Jupiter and Juno," in The History of Rocket Technology: Essays on Research Development and Utility, ed. Eugene M. Emme (Detroit: Wayne State, 1964), pp. 107-121. See also, Roger E. Bilstein, Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles (Washington, D.C.: NASA, 1980), pp. 23-56.
16. For a history of the Saturn program see Roger E. Bilstein, Stages to Saturn and David S. Akens, Saturn Illustrated Chronology: Saturn's First Eleven Years, April 1957 through April 1968 (Huntsville, Alabama: MSFC, 1971).
17. The brief descriptions of major facilities at MSFC are taken from the Marshall Space Flight Center, Master Plan, 1982.
18. National Register Nomination for Redstone Test Stand, Redstone Arsenal, Madison County, Alabama, May 1976.

Chapter 3

PRESERVATION RECOMMENDATIONS

BACKGROUND

Army Regulation 420-40 requires that an historic preservation plan be developed as an integral part of each installation's planning and long range maintenance and development scheduling.¹ The purpose of such a program is to:

- Preserve historic properties to reflect the Army's role in history and its continuing concern for the protection of the nation's heritage.
- Implement historic preservation projects as an integral part of the installation's maintenance and construction programs.
- Find adaptive uses for historic properties in order to maintain them as actively used facilities on the installation.
- Eliminate damage or destruction due to improper maintenance, repair, or use that may alter or destroy the significant elements of any property.
- Enhance the most historically significant areas of the installation through appropriate landscaping and conservation.

To meet these overall preservation objectives, the general preservation recommendations set forth below have been developed:

Category I Historic Properties

All Category I historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category I historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category I historic properties should not be altered or demolished. All work on such properties shall be performed in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 900).
- b) An individual preservation plan should be developed and put into effect for each Category I historic property. This plan should delineate the appropriate restoration or preservation program to be carried out for the property. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above referenced ACHP regulation. Until the historic preservation plan is put into effect, Category I historic properties should be maintained in accordance with the recommended approaches of the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings² and in consultation with the State Historic Preservation Officer.

- e) Each Category I historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.³ When no adequate architectural drawings exist for a Category I historic property, it should be documented in accordance with Documentation Level I of these standards. In cases where standard measured drawings are unable to record significant features of a property or technological process, interpretive drawings also should be prepared.

Category II Historic Properties

All Category II historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category II historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category II historic properties should not be altered or demolished. All work on such properties shall be performed in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 300).

- b) An individual preservation plan should be developed and put into effect for each Category II historic property. This plan should delineate the appropriate preservation or rehabilitation program to be carried out for the property or for those parts of the property which contribute to its historical, architectural, or technological importance. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above referenced ACHP regulations. Until the historic preservation plan is put into effect, Category II historic properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings⁴ and in consultation with the State Historic Preservation Officer.
- c) Each Category II historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.⁵

Category III Historic Properties

The following preservation recommendations apply to Category III historic properties:

- a) Category III historic properties listed on or eligible for nomination to the National Register as part of a district or thematic group should be treated in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800). Such properties should not be demolished and their facades, or those parts of the property that contribute to the historical landscape, should be protected from major modifications. Preservation plans should be developed for groupings of Category III historic properties within a district or thematic group. The scope of these plans should be limited to those parts of each property that contribute to the district or group's importance. Until such plans are put into effect, these properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings⁶ and in consultation with the State Historic Preservation Officer.
- b) Category III historic properties not listed on or eligible for nomination to the National Register as part of a district or thematic group should receive routine maintenance. Such properties should not be demolished, and their facades, or those parts of the property that contribute to the historical landscape, should be protected from modification. If the properties are unoccupied, they should, as a minimum, be maintained in stable condition and prevented from deteriorating.

HABS/HAER Documentation Level IV has been completed for all Category III historic properties, and no additional documentation is required as long as they are not endangered. Category III historic properties that are endangered for operational or other reasons should be documented in accordance with HABS/HAER Documentation Level II, and submitted for inclusion in the HABS/HAER collections in the Library of Congress.⁷ Similar structures need only be documented once.

CATEGORY I HISTORIC PROPERTIES

Redstone Rocket Test Stand (Building 4665)

- Background and significance. The Redstone Rocket Test Stand, built in 1953 and operational until 1973, tested the modified Redstone Rocket that carried the first American satellite into orbit in 1958. As noted in Chapter 2, the test stand and its associated block house are listed on the National Register of Historic Places. This property, although not yet 50 years old, was listed on the National Register because it was considered exceptionally significant to the development of the American space program (see Chapter 2, Marshall Space Flight Center: Description of Major Facilities, and Illustration 11). It is a Category I historic structure because of its strong association with the nation's space program.
- Condition and potential adverse impact. The Redstone Rocket Test Stand is protected and maintained as an historic structure at the arsenal, and there are no current plans to alter or demolish this property.

- Preservation options. Refer to the general preservation recommendations at the beginning of this chapter for Category I historic properties.

CATEGORY II HISTORIC PROPERTIES

Neutral Bouyancy Simulator (Building 4705), 1955
Solid Rocket Motor Propulsion and Structural Test Facility (Building 4572), 1957
Structures and Mechanics Laboratory (Building 4619), 1959
Acoustic Model Engine Test Facility (Building 4540), 1964
Structural Dynamics Test Facility (Building 4550), 1964
Propulsion and Structural Test Facility (Building 4670), 1965
High Reynolds Number Wind Tunnel (Building 4775), 1968

- Background and significance. These facilities were all constructed at NASA's Marshall Space Flight Center in support of the nation's space program, and their functions are interrelated. Many are directly associated with the development of the Saturn Launch Vehicle, which was used for the Apollo, Skylab, and Apollo-Soyuz missions. (For a detailed description of the individual structures, see Chapter 2, Marshall Space Flight Center: Description of Major Facilities.) These properties do not meet the eligibility criteria of the National Register for buildings less than 50 years old, but they should be reevaluated at a later date. All are Category II historic properties because they have a direct association with an important component of America's space program.
- Condition and potential adverse impact. The properties are all currently maintained by NASA. Some are being kept in "standby" condition, and others are still actively used by NASA and other branches of the armed services. There are no current plans to significantly alter or demolish these properties.

- Preservation options. Refer to the general preservation recommendations at the beginning of this chapter for Category II properties not listed on the National Register.

CATEGORY III HISTORIC PROPERTIES

Fire Station #3 (Building 7102)

- Background and significance. Fire Station #3 is a military building with unusual pretensions to style. It was constructed in 1942 as the main fire station for the Redstone Ordnance Plant. The two-story wood shiplap-sided building is derived from a standard World War II Army building prototype but varies from the prototype through the employment of such distinctive architectural features as a curved entry bay and a five-story watch tower. The building served as a fire station until recently and is now used as a general purpose administrative building. The building does not meet the eligibility requirements for the National Register of Historic Places, but is classified a Category III historic property because it possesses local importance as a work of architecture. (Illustration 21)
- Condition and potential adverse impact. Fire Station #3 is currently in good condition but is tentatively slated for demolition, although no definite demolition plans have been established.
- Preservation options. The general preservation recommendations for Category III historic properties not listed on the National Register advise against demolition and state that the facades of such structures

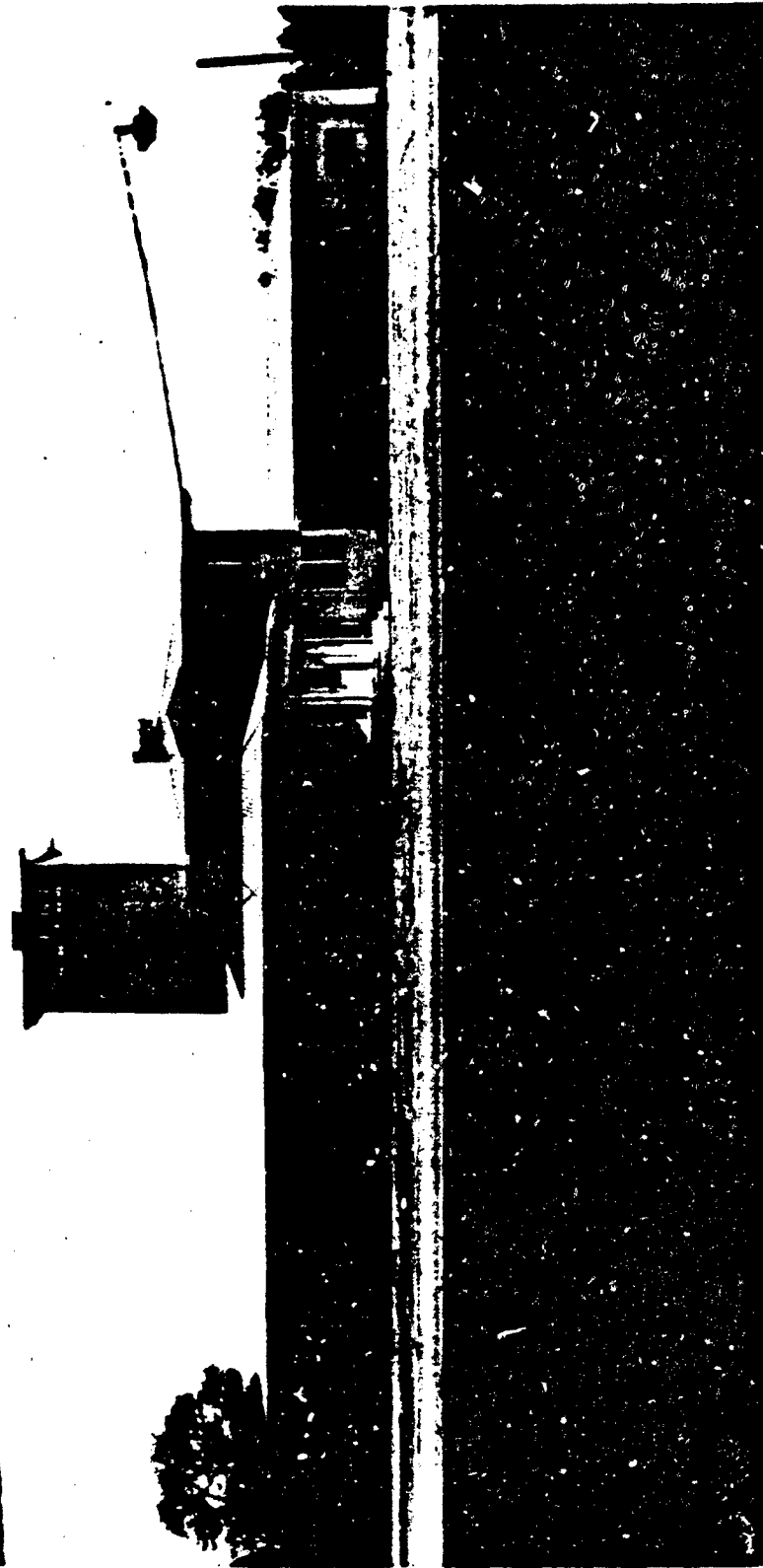


Illustration 21: View of north facade of Fire Station #3 (Building 7102) constructed in 1942 as main fire station for the Redstone Ordnance Plant. (Source: En-

should be protected from major modifications. If at all possible, an adaptive use should be sought for this building that will not alter its distinctive architectural character. If the property must be demolished, it should first be documented in accordance with HABS/HAER Documentation Level III, and such documentation should then be submitted for inclusion in the HABS/HAER collections of the Library of Congress.

Harris Residence (Building 8012)

- Background and significance. This house was constructed prior to military acquisition of the present Redstone Arsenal site. Although the exact date of original construction is not known, records indicate that a Mr. J. B. Harris combined two existing buildings, possibly slave quarters, in 1927 to form one house. The house was sold to Sam Harris in 1937 and was renovated in 1938 with the addition of new siding and porches. The house and property were purchased by the government in 1941. The Lee House, a larger house built in 1818 and once located just to the west of this residence, was recently moved from its original location off post to a Huntsville site. The Harris residence is a Category III historic property because it is locally unique to its historic era and contributes to an understanding of pre-military land use at the Redstone Arsenal site. (Illustration 22)
- Condition and potential adverse impact. The house is in good condition and is presently being adequately maintained. There are no current plans to alter or demolish this property.
- Preservation options. Refer to the general preservation recommendations at the beginning of this chapter for Category III historic properties.

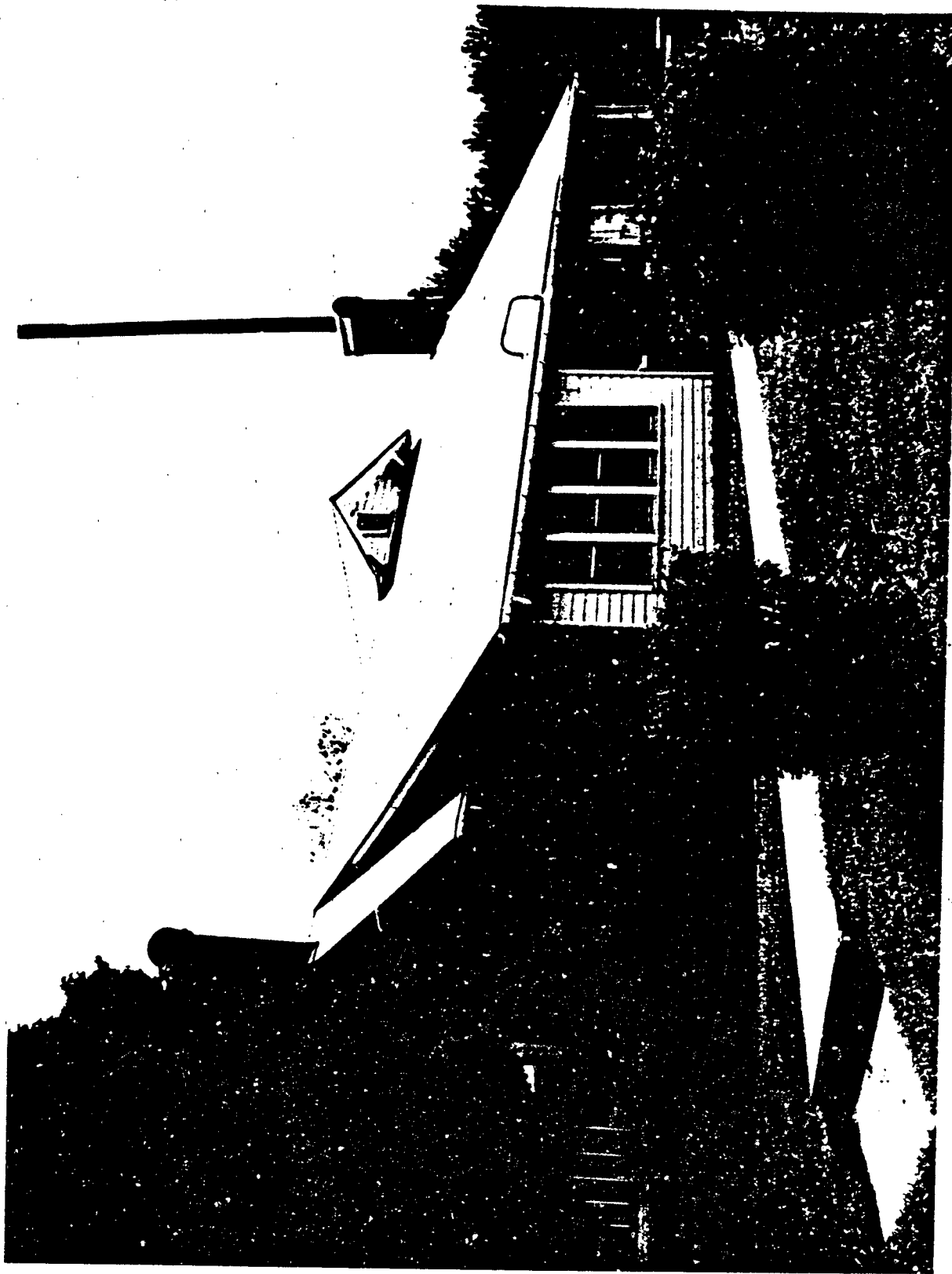


Illustration 22: View of south facade of the Harris Residence (Building 8012), a pre-military structure at Redstone Arsenal. (Source: Field inventory photograph, 1933, David G. Buchanan, Building Technology Incorporated)

NOTES

1. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1981).
2. National Park Service, Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings, 1983 (Washington, D.C.: Preservation Assistance Division, National Park Service, 1983).
3. National Park Service, "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Federal Register, Part IV, 28 September 1983, pp. 44730-44734.
4. National Park Service, Secretary of the Interior's Standards.
5. National Park Service, "Archeology and Historic Preservation."
6. National Park Service, Secretary of the Interior's Standards.
7. National Park Service, "Archeology and Historic Preservation."

BIBLIOGRAPHY

Redstone Arsenal

- Armed Forces Chemical Association. The Chemical Warfare Service in World War II. New York: Reinhold, 1948.
- Bartholomew, Harland and Associates. Analysis of Existing Facilities/Environmental Assessment Report, Redstone Arsenal, Alabama. Memphis, TN: Author, 1977. Description of existing facilities with a brief summary or the historical development of Arsenal.
- Brophy, Leo P., Niles, Wyndham P., and Cochrane, Rexmond C., The Chemical Warfare Service: From Laboratory to Field. Washington, D.C.: U.S. Army Office of Military History, 1959.
- Brophy, Leo P. and Fisher, George J. B. The Chemical Warfare Service: Organizing for War. Washington, D.C.: U.S. Army Office of Military History, 1959.
- Joiner, Helen Brents. The Redstone Arsenal Complex in the Pre-Missile Era: A History of Huntsville Arsenal, Gulf Chemical Warfare Depot, and Redstone Arsenal, 1941-1949. Redstone Arsenal, AL: Army Missile Command, Historical Division, 1966. World War II and post-War history of the three installations which comprise the present Redstone Arsenal. Bibliography included.
- Joiner, Helen Brents and Jolliff, Elizabeth C. The Redstone Arsenal Complex in its Second Decade, 1950-1960. Redstone Arsenal, AL: Army Missile Command, Historical Division, 1969. Description of rocket programs listed chronologically.
- Jolliff, Elizabeth C. History of the U.S. Army Missile Command, 1962-1977. Redstone Arsenal, AL: HQ MICOM, Historical Division, 1979. History of the programs at Redstone in the 1960's.
- National Register of Historic Places. Redstone Rocket Test Stand, 1976.
- Thomas, Prentice M. Jr. Cultural Resources Investigations at Redstone Arsenal, Madison County, Alabama. New World Research, Inc., 1980. Evaluation of cultural resources at Redstone with brief developmental history and land-use patterns.
- Thompson, Harry C. and Mayo, Lida. The Ordnance Department: Procurement and Supply. Washington, D.C.: U.S. Army Office of Military History, 1960.
- U.S. Army Missile Command. Redstone Arsenal. Redstone Arsenal, AL: DARCOM, Installation and Activity Brochure, 1961.

U.S. Army Toxic and Hazardous Materials Agency. Installation Assessment of Redstone Arsenal, Report No. 118. Aberdeen Proving Ground, MD: Author, 1977.

Marshall Space Flight Center

- Akens, Davis S. Saturn Illustrated Chronology: Saturn's First Eleven Years, April 1957 through April 1968. Huntsville, AL: MSFC, 1971, 5th ed. History of Saturn program with over 400 illustrations, many of test facilities at MSFC.**
- Bilstein, Roger E. Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles. Washington, D.C.: NASA, 1980. Illustrated official history of Saturn program with excellent notes and "Sources and Research Materials."**
- Brooks, Courtney G., Grimwood, James M., and Swenson, Lloyd S. Jr. Chariots for Apollo: A History of Manned Lunar Spacecraft. Washington, DC: NASA, 1979. Official history of Apollo development, references to MSFC.**
- Department of Defense and National Aeronautics and Space Administration. "Army-NASA Transfer Plan," unpublished agreement, December 11, 1959. DOD/NASA in-house agreement, MSFC Library.**
- Emme, Eugene M. The History of Rocket Technology: Essays on Research Development and Utility. Detroit: Wayne State, 1964. Background history for U.S. rockets and missiles.**
- George C. Marshall Space Flight Center. "Apollo-Saturn " Huntsville, AL: MSFC, NASA Fact Sheet, 1980. Apollo-Saturn highlights in 7 pages.**
- George C. Marshall Space Flight Center. Facilities Data Book. 1982. Major buildings at MSFC, photos and reduced drawings (elevations, floor plans, site plans).**
- George C. Marshall Space Flight Center. Master Plan. 1982. Illustrated presentation format of mission, capabilities and facilities.**
- George C. Marshall Space Flight Center. Real Property Inventory. 1983. Buildings in numerical order with dates of construction.**
- Stuhlinger, Ernst. "Army Activities in Space - A History," Institute of Radio Engineers, IRE Transactions on Military Electronics, Vol. 49-4, No. 2-3, April-July 1960. Eye-witness account of Army rocket and missile programs in 1950s.**